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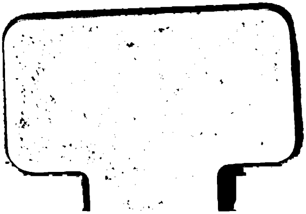
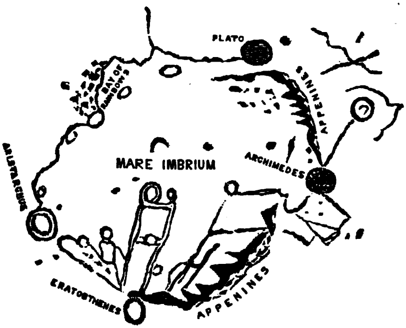


The Lunar World,

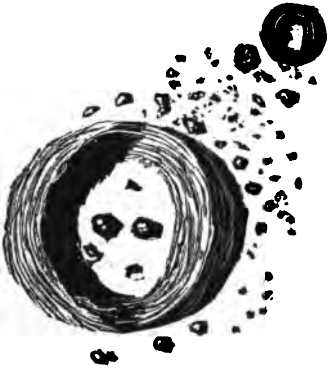
ETC.

Plate III.—Fig. 1.



MAP OF THE MARE IMBRIUM,
WITH THE APPENINES AND THEIR SHADOWS.

Fig. 2.



TELESCOPIC VIEW OF A LUNAR CRATER.
A Sketch from Nature, December, 1852.

THE LUNAR WORLD:

ITS

Scenery, Motions, Etc.

[CONSIDERED WITH A VIEW TO DESIGN.]

BY

JOSIAH CRAMPTON, A.M.,

RECTOR OF RAHENY,

Author of "Descriptive Astronomy," "Recent Discoveries," "Solar Eclipse,"
&c., &c.

"There is one glory of the Sun, and another glory of the Moon."—
1 Cor. xv. 41.

DUBLIN:
GEORGE HERBERT, 117, GRAFTON-STREET.
LONDON: HAMILTON AND CO., NISBET AND CO.
EDINBURGH: W. P. KENNEDY.
1853.

184. c. 8.

Preface.

———"The broad circumference
Hung on His shoulders, like the moon, whose orb
Through optic glass the Tuscan artist views
At evening, from the top of Fesolé,
Or in Valdarno, to descry new lands,
Rivers, or mountains, in her spotty globe."
MILTON.

IT is a remarkable circumstance, that the increase of telescopic power has not done so much in the way of discovery upon the surface of the Moon as might naturally be expected, and as it *has* done in reference to other astronomical objects, such as the nebulæ, &c.

None of the dreams of speculators upon a new world have as yet, at least, been realised in the case of our satellite; and what is *now* seen with monster telescopes is only what has been seen in the days of Galileo, Huyghens, and Newton, with instruments of more moderate pretensions, but a little more magnified in the present day. A gulf of space, however, still remains between us and our nearest neighbour in the heavens, which it is still questionable whether it will be permitted to man ever to pass.

If, indeed, there is a possibility or probability of it, it will be at least tested by the two gigantic and magnificent rival instruments in preparation for it—viz., Lord Rosse's reflector and Mr. Craig's refractor. If two eyes be better than one, we may naturally expect that two giant telescopes will do more than one; but the former of these, as was suggested at the meeting of the British Association at Belfast, last Autumn, by the President, is to be directed by its noble proprietor to a systematic and close survey of the lunar regions: and as Dr. Robinson has stated that a space of seventy yards on the lunar surface can be distinctly seen with this wonderful instrument, whose powers have hitherto been chiefly confined to nebulæ, we may naturally expect some additional and interesting discoveries from this effort. Enough, however, has been seen by astronomers, and even by the author himself, in a more humble way, and with instruments of far inferior power, to assure him of the general configuration and nature of the lunar surface, as described in the following pages, and illustrated by the accompanying plates (*see page* 5); while the perfect knowledge of lunar motions that has been attained, seems admirably adapted to set forth the glory of Him who has ordained them expressly for our benefit. For this end and object, indeed, chiefly the sketch that follows has been designed: the facts have been collected, not only from the best works and the most recent authorities, but from the author's own personal observation of nearly fifteen years, carried on as a delightful and ennobling recreation, rather than a study; but the labour of collecting the facts for the press, and putting them in a popular form, free from technicalities, interrupted continually by more pressing and important avocations, together with the scantiness of opportunity for observation in this variable climate, has not only delayed the publication beyond the time anticipated, but must plead as an apology for the many imperfections that will doubtless be perceived in it. The design of this work, however, as already stated in reference to its predecessors, is not simply astronomical or scientific. Many such treatises exist far superior for those who like them. It is the religion of astronomy which it is the desire of the writer of these pages to unfold; and it is to be lamented that comparatively few treatises of this nature upon scientific subjects are to be met with.

However needful science may be, there is one thing more "needful;" and, adopting the sentiments of the Rev. Leigh Richmond, expressed to his children upon this subject, the writer desires to say — "I will never consent to shut God out of his own universe, or divorce science and religion, which he has joined together to dwell with each other in unity and love." To this treasury of God in the world of nature, then, the author here throws in his mite, earnestly praying that the perusal of the following work may be blessed to those who read it, as God alone can bless it.

"For never yet did philosophic tube,
That brings the planets home into the eye
Of observation, and discovers, else
Not visible, His family of worlds:
Discover Him that rules them; such a veil
Hangs over mortal eyes, blind from the birth,
And dark in things divine. Full often, too,
Our wayward intellect, the more we learn
Of Nature overlooks her Author more;
From instrumental causes proud to draw
Conclusions retrograde, and mad mistake.
But if His Word once teach us—shoot a ray
Through all the heart's dark chambers, and reveal
Truths undiscerned but by that holy light,

Then all is plain. Philosophy baptised
In the pure fountain of eternal love
Has eyes indeed, and viewing all she sees
As meant to indicate a God to man,
Gives him his praise and forfeits not her own."

COWPER.

J. C.

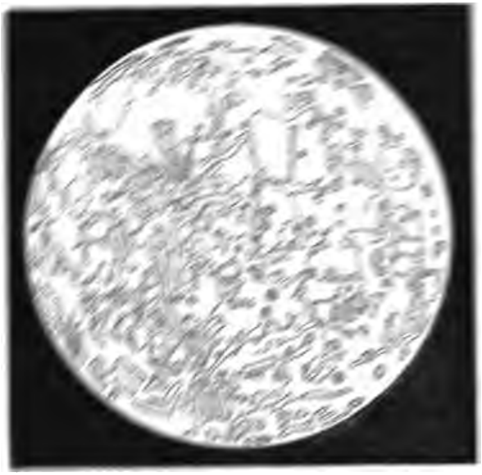
Raheny, April, 1853.

The Lunar Maps represented in Plates I. and II. are intended as a guide to the places which are of interest upon her surface; Plate II. being the appearance she presents to the eye, and Plate I. a key to the various spots, consisting of mountains, craters, &c., which are numbered in the catalogue. The Maps of the Moon by Messrs. Beer and Mædler are the most minutely accurate; but the following (from the Penny Cyclopædia) seem better adapted for popular use.

ERRATUM.

Page 51, line 11, *for* "sun" *read* "earth."

[illegible]



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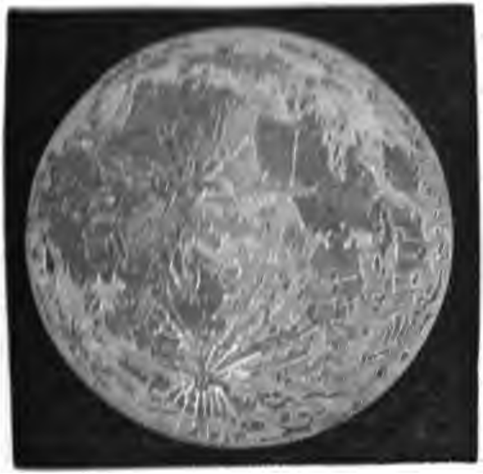
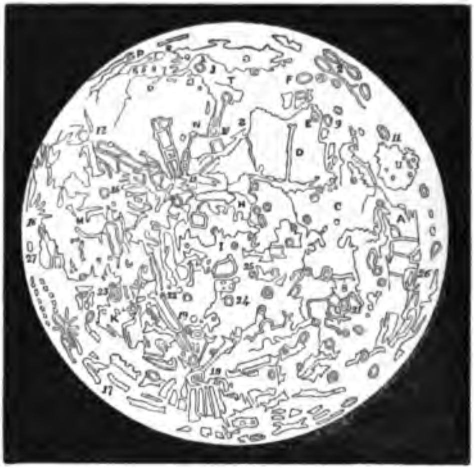
11, [illegible]
12, [illegible]
13 [illegible]
14 [illegible]
15, Kepler.
16, [illegible]
17, [illegible]
18, Tycho.
19, [illegible]
20, [illegible]
21, [illegible]
22, Bullialdus.

Plate II



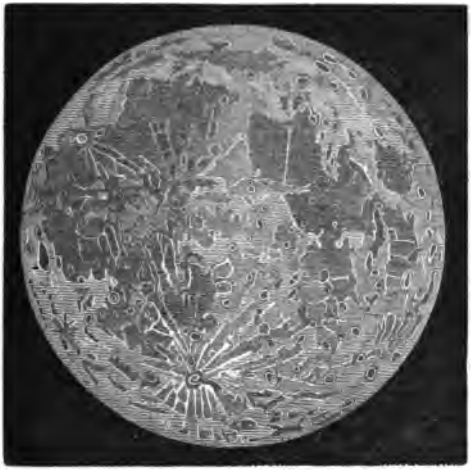
23. Gassendus.
24. Arzachel.
25. Ptolemy.
26. Langrenus.
27. Grimaldus.
A. Mare Fœcunditatis.
B. Mare Nectaris.
C. Mare Tranquillitatis.
D. Mare Serenitatis.
E. Lacus Somniorum.
F. Lacus Mortis.
G. Mare Frigoris.
H. Mare Vaporum.
I. Sinus Æstuum.
K. Mare Humorum.
M. Oceanus Procellarum.
N. Mare Imbrium.
O. Sinus Iridum.
P. Sinus Roris.
Q. Terra Pruinæ.
R. Terra Siccitatis.
S. Palus Nebularum.
T. Terra Grandinis.
U. Mare Crisium.

Plate I.



1. Pythagoras.
2. Endymion.
3. Plato.
4. Aristotle.
5. Hercules.
6. Atlas.
7. Heraclides falsus.
8. Heraclides verus.
9. Posidonius.
10. Archimedes.
11. Cleomedes.
12. Aristarchus.
13. Eratosthenes.
14. Copernicus.
15. Kepler.
16. Hevelius.
17. Schickardus.
18. Tycho.
19. Pitatus.
20. Petavius.
21. Fracastorius.
22. Bullialdus.

Plate II.



23. Gassendus.
24. Arzachel.
25. Ptolemy.
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A. Mare Fæcundatis.
B. Mare Nectaris.
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THE LUNAR WORLD,

ETC.

CHAPTER I.

Comparative Geography of the Earth and Moon—Terrestrial and Lunar Maps—An Island World in the Heavens—A Midnight Diorama—The Journey—Mode of Travelling—Sketches of Lunar Scenery—First Flight through Space—General Survey—Appearance of the Moon on approaching her—Obstacles—Disappointment—Incredulity—Explanations—Second Flight through Space—The Real and Ideal.

It is a curious, and, indeed, an humbling reflection, that it has taken man six thousand years to become even tolerably acquainted with this world, in which the Almighty has placed him. Slowly and gradually, when measured by time, though but momentarily when compared with eternity (as emmets disperse themselves over their hillock), he has extended the bounds of his habitation, and enlarged his knowledge of the globe on which he lives, till he has almost grasped the problem of the universal geography of the earth; and a few years more will probably bring about the strange result, of a child of the dust being enabled proudly to say—"With the exception, indeed, of those icy pinnacles, where no human foot could stand; or those sun-scorched, airless deserts, where no lungs could breathe freely; or those impenetrable forests, through which no human force could make its way—there is not a spot on this wide world now where I have not been—there is not a country or a clime with which I am not acquainted—there is not an ocean that I have not sounded, nor a sea that I have not traversed, nor a mountain that I have not climbed—there is not an island strand (however lonely) where the keel of my boat has not grated—there is not a river that I have not traced to its source—nor a nation, or a people, or a city, that I have not recorded in my map."

This climax is not so far off, perhaps, as some think; and with the exception of Central Africa and New Holland, but little remains to be learned of the earth, geographically. In the meantime, however, the busy mind of man has not been idle; and, baffled for a while in obtaining a perfect map of his own world, he has turned his eyes and attention upwards, and absolutely entered on the geographical—or, rather, lunographical—examination of a neighbouring world, *i.e.*, our own beauteous satellite—another house, apparently, in the boundless city of heaven—another island in the blue ocean of space—another bright mansion in the glorious palace of God—a silvery globe—an illuminated map, hanging suspended, as it were, in mid air, for our nightly inspection. He has gladly availed himself of the opportunity; and, arming himself with a giant's eye, when the air is calm and still, and the moon rolls in quiet beauty through the firmament, the astronomer has taken his post, and, amidst the deep silence of night, and the profound repose of nature, has examined and scrutinised every feature of her shining landscape. While others are wrapped in slumber, he is climbing her mountains, and traversing her plains, and crossing her valleys. He has already measured her depths, and scanned her heights, to a foot. He is standing, on a lunar morning, upon her golden mountains, to see her sunrise; he is gazing, on a lunar evening, at the fast-retreating light, as it vanishes from her mountain peaks, and the swift-coming shadows, as they creep over that solemn plain across which he has already in spirit travelled for 1,500 miles. In short, everything that *could be* done *has been* done in the way of observation; and then the micrometer has been at work, and a scale has been made, and a map formed more accurate by far than any terrestrial map, containing every winding of every bay — every rocky promontory—every steep defile—every mountain and vale — every hollow plain and river, if such a thing exists—until there is not a peculiar feature of her scenery, or a spot on all the surface she presents to us, to the space of one hundred yards, that is not recorded for our inspection. But this is not all: what the human hand could not effect, or, at least, effect imperfectly, the human mind has contrived to do, by the adaptation of the most wonderful and beautiful of modern discoveries, so that the silvery map in the heavens, at a distance of 240,000 miles, is made literally to transfer its own impression to a metallic plate, in the hands of the astronomer on earth, with every lineament and minutia of her face imprinted and described with a divine accuracy and perfection, which increases in proportion to the magnifying power applied.*

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* *Vide* Appendix A.

Thus we have an island world in the heavens revealed to our gaze; and ere long, no doubt, these photographic maps will be in every one's hand; and while the astronomer continues still to search with his wondrous instrument, whose power and capabilities seem to be daily increasing, each of us will be enabled to lay his map before him, and, with a small magnifier in our hand, to trace out every feature of our neighbouring world.

But what has been done hitherto in the way of discovery in this strange land—what facts have been ascertained—what *may* be seen, and what *has* been seen—on such a survey; and what are the conclusions which we are led to form respecting the nature of the lunar globe, are questions which it is the purpose of this little sketch to reveal.

That the chief intention of the Almighty in giving us a moon was to give light to the earth, is plain; as the sun is "to rule the day, so the moon is to rule the night;" that there are many other equally, if not more important objects it subserves, such as the regulation of the tides, &c., a comparatively slight acquaintance with her astronomical condition as our satellite can show;—these shall be considered in their place. But we are at present merely regarding her physical condition—looking *into* her rather than *at* her; and we want to know, not so much what she does *for* us as what she *is* herself, both geologically and geographically; whether, from such an examination of her surface, we are to regard her as a world like our own, or as a desert rock and unpeopled solitude; as a mere lamp and regulator for the earth, or as an independent sphere, suited for intelligent creatures, and possessing resources within itself accordingly. While it is not likely, indeed, that we shall ever be in a position to arrive at *absolute* certainty in the matter, yet a number of probabilities may be put together, which will afford at least presumptive evidence as to the conclusions that may fairly be drawn; and give an opportunity for an inquiry of no slight interest, and the exhibition of a country, not, perhaps, as well known or as familiar to many of the readers of this work as to the writer.

In order to answer these questions satisfactorily, then, I would at once propose a short excursion to the moon, and ask my readers to accompany me. When there, I will endeavour to point out each feature of interest, as it presents itself to view. The machine, or vessel, that I have provided for our journey is of very simple, and, indeed, somewhat ancient construction: it consists of a tube of tin, ten feet long, and six inches in diameter, to which are adapted certain glasses, or lenses, and brass tubes, by the aid of which different powers of locomotion can be applied, and, with the velocity of light, we can be thus transported to within a few miles of the country we purpose to visit; from which undisturbed elevation in space, looking down (as though seated in the car of a balloon, on a calm, clear day), we can take a bird's-eye view of lunar scenery. Indeed, the sketches that accompany this work have been thus taken, the shapes of the mountains having been copied from their shadows, and the craters in like manner, as accurately as circumstances would permit; and the landscape afterwards reduced to the natural perspective in which it would appear to a person on the surface, instead of beholding it from a height.

If somewhat of the ideal has been found necessary to be introduced, in order to fill up the details of these views, it can at least be affirmed, that as delineations of the general and main features of that strange land, they are correct; and will, probably, help to convey a better idea of its real character than any mere diagrams could, to persons unaccustomed to telescopic observation.

And now for the first flight through space.

Choose a fine, clear night, when the air is calm and still, and the dew is dropping from the dew-cap of the telescope. Apply a power of sixty.* What was matter of conjecture before respecting the nature of the moon, is now become unquestionable certainty. The globular form of our satellite is now distinctly perceptible; she has widened in her dimensions considerably, and she appears as a huge ball of molten silver, suspended, without any support, in the dark blue æther that surrounds her. But her surface also is changed: she is evidently a solid body of rock, or some such substance, and she is perforated with innumerable holes, rents, and fissures, of every size. The tracing of the dark patches, called seas, are there still; but their character is evident—they are not seas, but dry depressions below the surface—the bottoms of oceans, now no more, or the cradles for future waters; but nothing of this kind covers them now. They, too, are perforated with holes innumerable; huge rocks are scattered here and there over their surface; no lunar cloud ever obscures them. They are sandy or rocky plains, of different depths and extent; and, as is the case in the bottom of our seas, are bounded in some places by a steep ridge, or chain of mountains.

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* *Vide* Appendix B.

But advance nearer to this wondrous object—take another huge stride through space, and at once the reality bursts upon you. You are approaching no minute body, as she appears to the naked eye—no small, bright, calm, and lovely star—but a huge world—and a world of apparent disorder, of fearful wreck and ruin.

But here we may observe, that, as in approaching the shores of an unknown country or island, in a ship, many optical deceptions exist, which prevent us from forming a correct notion of the nature of the soil, so in the first glance at the moon which persons unaccustomed to telescopic observation give, but little idea is generally obtained respecting the nature of the object which they see; and much disappointment has been felt and expressed, simply from the unreasonable expectations that have been formed.

The moon, although resembling our world in some particulars, seems (as far as we can ascertain) to be very different in others; as different, indeed, in its general aspect and appearance, in all probability, as the earth we inhabit once looked in its primeval state, previous (geologically speaking) to its sedimentary and tertiary formations, and alluvial deposits. To this we may add, the great distance at which, even under the most favourable circumstances and the most powerful telescopes, we can behold her: a power of five hundred, which is the highest that can be used with advantage, leaving us still at a distance from her of nearly 500 miles, while a power of 10,000, were it possible to apply it with distinctness, would bring us no nearer than twenty-four miles; and the highest magnifying power yet applied will only enable us to perceive, and that as a visible point, an object whose diameter is from 70 to 100 yards, or about 300 feet. If to this be added the inexperience of three-fourths of those who look through a telescope, and the infirmity of vision of others, together with the utter incapacity of many to judge of distance, perspective, &c., we shall not be surprised at the disappointment of some, and the scepticism of others, at what they call, the pretended discoveries of astronomers in the moon, when they compare them with their own unpractised observations, and the unmeaning figures that appear to present themselves to their view the first time they get a glimpse at her through the telescope, particularly as having always heard there were mountains and valleys to be seen, they expect to see them exactly as they would a terrestrial landscape, or as they are delineated in the sketches in this book; which they never can, being seen from a height, when the diameter of their mountain summits, or hollows of their craters, alone can be perceived.

In the face, however, of such obstacles, we advance in our telescopic vessel nearer to this island-world; and although to the inexperienced eye it may look like the sugar on a huge frosted plum-cake, or a globe of alabaster or plaster of Paris, magnified—pierced with innumerable holes, and raised with numberless excrescences—we are enabled, viewing it with an astronomical eye, to see a round world, 2,000 miles in diameter; in those holes, to recognize its valleys and craters; in those excrescences upon its surface, its lofty mountains; in those dark shadows, its vast plains. Once get the conviction of this fact upon the mind—a fact, be it remembered, previously demonstrated by the most rigid laws of mathematics—bring the imaginative power to aid in the work of transporting you there, and the search after the picturesque—either the calm and soft, or the gigantic and terrible, as they are exhibited in lunar scenery—will be not only easy, but delightful; while there will be as little difficulty experienced, after some practice, in giving to the objects we see on such a small scale their real magnitudes and proportions, as there is in giving them to the features of the terrestrial landscape, in the picture that hangs upon our wall within its tiny frame.

CHAPTER II.

Lunar Mountains — Search after the Picturesque — Geological Speculations—Qualifications for Lunar Travelling—Wanderings in the Mare Imbrium — Pico — The Appenines — Bay of Rainbows — Mountain Chains — Terrestrial Analogies—Impression produced by Lunar Scenery—Eratosthenes—Lunar Craters—Wall-surrounded Plains—Radiating Craters.

AMONG the most remarkable features of lunar scenery are her mountains. With these the moon is overspread; they occupy, indeed, not less than two-thirds of the entire disc which she presents to us. Of what nature her surface is composed upon the other hemisphere we can never know, as she presents always the same face to the earth; but from analogy we may fairly conclude it is not materially different. But not only are her mountains more numerous, in proportion to her size, than those of the earth, but they are much larger, rising to a much loftier elevation, composed, apparently, of a substance of a much harder texture than anything terrestrial, and exhibiting bolder and sharper outlines, and more tremendous precipices, some of which project and overhang each other in such a manner as to lead many to suppose, that the rocks composing them are of a harder and more solid nature than wrought-iron.

In these particulars, as well as in an extraordinary power of reflection which some of them possess, and which illumines them occasionally, as with a phosphoric light, they differ from terrestrial mountains. Of what the substance is of which they are composed, it is, however, of course, impossible to conjecture, except from the stratified appearance which is quite perceptible in some of the precipitous sides of the lunar craters, and which running horizontally, in a terrace-like conformation, has led some geologists to conjecture something similar to that of our trap-rock.

But we continue our telescopic journey; and now that we are about to take our last flight, which is to land us upon the lunar soil, we must call in the imaginative power to our aid; and let us suppose ourselves to be angelic beings, who can exist in any climate, or any atmosphere, or in none—for this is needful for lunar travelling. Adapt a power of about 150 to our aerial vessel, which will be sufficient for our purpose. Choose the period of the last quarter; and direct our way to that dark, shadowy spot marked N in the map, and situate at the north-eastern portion of the lunar globe—it is the Mare Imbrium, or Sea of Showers, as it is called, though no water is to be found there, and no shower ever cools or moistens its barren surface. It is about 700 miles in extent every way. Let us cast our eyes around, and what do we see?—a boundless plain, or desert, stretching away as far as the eye can reach on every side, save in one or two points, where a chain of lofty mountains can be perceived, whose brilliant, pointed summits, glittering in the sunbeams, just appear upon the distant horizon. The light that glares upon the plain is intense, and the heat of a tropical fierceness, for no cloud shelters us. By that light we may perceive, scattered over the plain, an infinite number of circular pits, of different sizes and depths, varying from a few yards to some hundred in diameter, and sunk in the body or crust of the planet; some of them but a few feet and others to an unknown and immeasurable depth. Above, the sky is black, out of which the sun gleams like a red-hot ball; and the stars sparkle like diamonds—for no atmosphere such as ours exists, to give by its refractive and reflective powers the delicious blue to its heavens, and the softened shade to its landscape. The lights and shades are indented upon its features deep and dark, or intensely bright; no softening away in the distance, no gentle and beautiful perspective, no lovely twilight—morning or evening—stealing over or away from the scene. All the shadows are abrupt, sudden—all the outlines sharp, clear; appearing startlingly near, even when really distant. No sound follows our footfall, or is ever heard in that silent place—for there is no atmosphere to conduct it; no fresh breeze blows on its mountain-tops, sighs through its burning deserts, rustles through the brilliant green of forests, or waves over meadows; the silence of death broods over its arid wastes and rocky shores, against which no tides or billows break.

But onward let us bend our steps towards that magnificent range of mountains, whose peaks glitter on the horizon, some 17,000 or 18,000 feet above the plain on which they stand. This is one of those features on this desolate globe that presents the greatest analogy to our own—no chain of terrestrial mountains could be more perfectly represented. But what is that huge, dark object to the left, standing

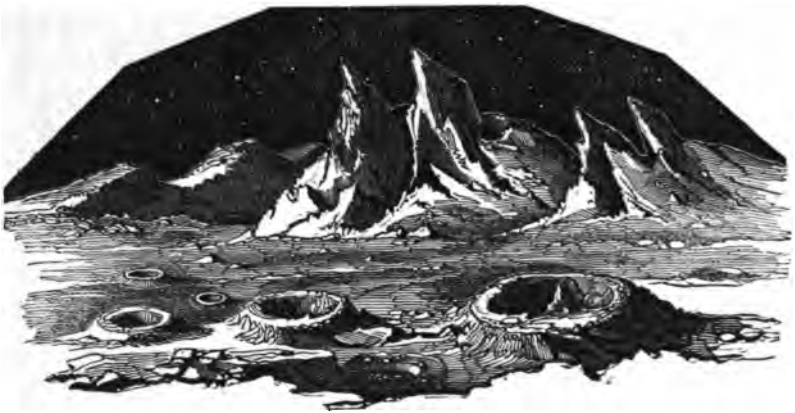

Plate IV.] THE LUNAR APPENINES, FROM THE MARE IMBRIUM.

alone in this waveless sea? It is Pico, a well-known rock;* 7,000 feet perpendicularly it rises from the plain. Its outlines are sharp and pointed: it seems either as if some tremendous convulsion had pushed it up through the soil, or that the surface had as suddenly subsided and sunk from around it, leaving it standing bare, naked, and solitary—casting its giant shadow for miles away over the desert.

But now for the Appennines. Peak rises behind peak, pointed as Teneriffe, but far more lofty; their summits shine like silver, illuminated as they now are by the fast-descending sun, which is stealing away from them, soon to leave them, and the plain upon which every outline of their form is distinctly traced, in the deepest darkness. As we approach them, to the right, we perceive that they form a bend, or curve, extending in a continuous range for near 600 miles; and that they are the boundary of the sea, or plain, in that direction. Their summits are Alpine rather than Appennine—some of them, such as Huyghens and Bradley, attaining respectively to 18,000 and 13,500 feet in height. While they slope away in a gradual declivity at the back, they form a chain of tremendous precipices next the sea, or plain, presenting sharp and jagged outlines, and fearful chasms, whose shapes are distinctly perceptible upon the plain below.

We are now in the Bay of Rainbows, considered one of the most beautiful spots on the moon. Here we are struck at once with the resemblance it bears to many terrestrial scenes that we are familiar with, and there is less effort of imagination necessary to transport ourselves there. Just before we have been out on the desert plains of Africa or Asia, now we are spectators of the lofty Himalayas, or precipitous Andes; but there is still mingled with this sensation something of the wild and terrible that accompanies us wherever we go on this globe, and of which we cannot ever divest ourselves altogether. There is, indeed, a character quite its own in all lunar scenery (even in the softest and most beautiful parts of its landscape), which never lets you for a moment forget that you are in a land that is "not of earth." The wonderful and extraordinary clearness, the intensity of the light and the blackness of the shadows, the sharply cut and pointed summits of the mountains, the perfectly circular craters, and pits, and caverns, cut as though they had been marked out with a compass before they were hollowed—all this conveys a preternatural and strangely wild appearance. You feel at once that you are in another world, and one of emptiness, and waste, and ruin—a globe that, in its geological history, has passed through fearful times; and, as you survey the desolation of its calmest and softest scenes, and bring them close to your eye, in the dead hour of the night, when there is nothing to interrupt the full impression it produces, you start back with an indescribable sensation—it is that of silence and intense solitude—which creeps over you, till it becomes for the moment oppressive and almost insupportable. You feel at once persuaded, while the eye ranges over those lifeless wastes, that instead of being clothed with verdure, as some have conjectured, or crowded with populous cities and inhabitants, that, if ever there was a realization of perfect solitude, it is there—if ever there were dry places, where lost spirits might be imagined as "seeking rest and finding none," it would be there.

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* Situate a little to the north of Plato.

But what are these frowning ramparts, or walls of rock, that stand before us, and seem to prevent further progress? We have now reached the southern boundary of the Mare Imbrium, and the end of the Appennine chain, of which this seems the last link. Over rugged rocks let us ascend for 3,000 feet, till we reach the edge, and look down. What a scene is revealed! We are on the brink of a lunar crater—it is Eratosthenes, considered one of the most beautiful, though not the largest, of the same class, which may more properly be called wall-surrounded plains. This has been named by Hevelius, the mighty key-stone of the Appennines, which its position justly entitles it to be called. (*See Plate III., Fig.* 1.)

We are on the edge, then, of a circular rampart, or precipice of rock, enclosing an area or space of thirty-seven miles in diameter, or about one hundred miles in circumference. Far down on the surface of the interior plain below—some 6,000 feet, and therefore 3,000 feet lower than the lunar surface outside—from the very centre of the circle rises majestically a steep, conical-shaped mountain; for 15,800 feet it shoots its sharp summit into the sunbeams, which bathe it in golden light, while its base is enveloped in sombre shadow. There it stands, frowning in solemn majesty on the rocky waste around, the sole monarch of the space within its dismal boundary; whose silence awes, whose solitude oppresses, and whose terrific grandeur takes away the breath.

This is a specimen of the general character of the lunar mountains with which her surface is covered—the mountain ranges, or chains, forming the exception. The number of these isolated cones, placed in circular plains or hollows, varying from a few yards to above a hundred miles in diameter, is past counting; but whether standing alone, as some do, or crowded together, till their circumferences break in one upon another, like the cells of a honeycomb broken—as they are to be found in the southern portion of the moon, and in the neighbourhood of Tycho—their formation is the same, differing only as to size and depth, and the circumstance of a central mountain—some having none, while others have two or more; while across some a ridge extends, running either the whole or only part of the way, while in the centre of some a deep gulf seems to open. The surface of these circular plains affords a variety of colouring, which with our present powers of vision cannot be satisfactorily accounted for, some being of an ashy grey (a colour which generally belongs to those *without* any central mountain), others being of a whitish shade, some few of a red colour, and others of a faint green, which has led some to suppose the existence of a vegetation resembling that of the earth. The shape of the surrounding cliffs can readily be perceived by the shadows they project on the surface of the plain below (*vide Plate III., Fig.* 2), as we have often seen in the

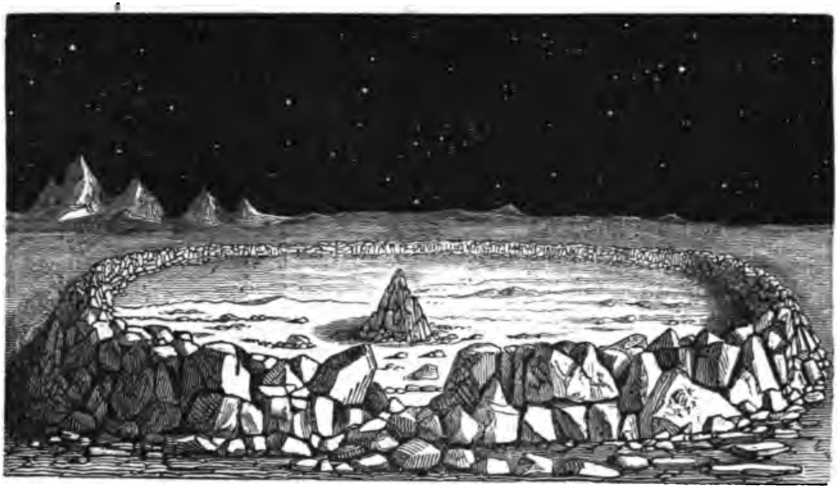

Plate V.] **WALL-SURROUNDED PLAIN IN THE MOON.**

hollows of our mountain lakes, which many of them resemble, if we imagine a sandy plain at the bottom instead of water. When there is a central mountain, its shadow is distinctly cast upon this plain, by which its shape can be ascertained and sketched, and its height measured trigonometrically.*

Thus are we led to perceive, that while our satellite possesses some features in common with her primary, the nature and general distribution of her surface is very different.

There have been many speculations upon the cause of this singular crateriform structure, of which the earth seems to afford but comparatively few analogous specimens. The natural and usual solution of the question, however, hitherto received has been, that it owes its origin to volcanic force, of a similar nature to those in operation upon our own globe; and that Etna, Vesuvius, Teneriffe, and Hecla, together with the other active or inactive cones of disturbance, are the types of the lunar, which they seem to resemble in many particulars; only instead of being confined to a few points, as here, they operated universally over the lunar surface, as we should find *was* probably the case upon the earth before her sedimentary deposits had covered, as with a garment, the naked and torn bosom, now so fertile; which was designed to be afterwards a habitation for God's last and greatest work.

I am inclined to think (though, of course, it is a question that does not admit of positive proof) that this is the true history of lunar disturbance, although it must have been of a peculiar character, and of a very violent nature. A remarkable evidence of this, indeed, is afforded by a peculiar feature in lunar scenery. There are some of her craters to which the name radiating has been given, from the appearance of straight, white lines, which radiate from them in every direction, like the glory round the head of saints, and extend, some of them, to a vast distance across the surface of the planet—sometimes crossing each other, but pursuing their course, like our railroads, only accommodating themselves to the nature of the ground, without suffering anything to impede them or turn them aside into the slightest curve; now ascending mountains, and now descending into the very bottom of craters, cutting them, as it were, in two, without the least deviation. One of these remarkable lines can be perceived with the naked eye, proceeding from the crater called Tycho, situated in the southern portion of the moon's hemisphere, where, probably, the greatest disturbance has taken place, and where craters and mountains are crowded upon one another, in wild and terrible profusion. This line that thus radiates from Tycho (which is a vast, deep crater, with a central mountain, and a chasm fifty-five miles across) spans nearly the entire disc of the moon; and can be perceived with a telescope, as a white, shining line, crossing the Mare Serenitatis, having run a course of nearly 1,700 miles! The full moon is the best period for observing these rays, which, as they generally throw no shadow, have somewhat perplexed astronomers. The explanation usually given, however (which is probably the truth), is, that these radiating craters were successively the centres of a terrible convulsion,* which operated on the crust of the moon as the blow of a stone would upon a piece of plate-glass, sending out sloping but elevated ridges in all directions from the centre of disturbance.

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* Appendix C.

* As the rays from different craters cross each other, they are observed to eclipse, or conceal one another at the points of intersection, evidently according to the age or chronological era of the crater, whose rays thus, like the hands of a clock, point out the order and time of the successive eruptions—and, probably, the original formation of each crater. Professor Nichol thus clearly explains this theory :—" If a ray or vein from one granite cuts the vein of another granite, we instantly infer the posteriority of the former. Now, I find that rays from Kepler cut through rays from Copernicus and Aristarchus, while rays from Aristarchus also cut through rays from Copernicus; there is, therefore, no doubt whatever as to the ages of these interfering streams. They stand in this order—Copernicus, Aristarchus, Kepler."—*Nichol on the Solar System*, p. 165.

CHAPTER III.

Tycho—Copernicus—Chaotic Scenery—Volcanoes—Water—Atmosphere—Different Conclusions respecting the Lunar World—Speculations—Facts.

AMONG the radiating craters, the most considerable in size and importance are Tycho, Kepler, Plato, and Copernicus. The former of these to which we have already alluded is, perhaps, the most remarkable, and the best worth a visit, when it is in a favourable position for telescopic observation, which is about the period of half moon. It lies in the southern part of the lunar surface, and can be plainly perceived with the naked eye at the full moon, being one of the most conspicuous objects. An attentive observation of it and its vicinity, with the telescope, reveals a scene unparalleled by anything terrestrial.

We are in the highlands of the moon here; but the grandeur of the glacier solitudes of Mount Blanc are presented to the eye, mingled with the frowning precipices of the Andes, or the ashy desolation of Hecla; far as the eye can see on every side, mountain-tops and ridges stretch away interminably, so as not to present one spot of level ground on which the sole of the foot could rest, varied by the gaping mouths of deep caverns or pits, of unknown depth, into the bottom of which the sun never shines, and with which this chaotic part of our smiling satellite is absolutely honeycombed. With a telescope of small power it is, indeed, a very beautiful sight, and appears like a golden lace-work; but when you examine it closely, it is very different. If any part of the moon be inhabited (which is more than improbable, indeed, from the knowledge we have now of her condition), certainly this part is likely to be an exception, for never did eye gaze upon a wilder or stranger scene. Let us, in imagination, stand for a few moments within the arena of Tycho. Around us, on every side, rises a mighty wall of rock, extending in a circle of 150 miles, or 54 in diameter. Looking up from the interior plain, it is 17,000 clear feet of precipice before the eye rests. Before us extends a plain for about 25 miles, interrupted, however, by concentric ridges of rocky mountains, or barriers, that encircle (in irregular and broken masses, of fearful magnitude and height) the awful centre, whence, from a black and profound gulf, that opens its mighty jaws, springs a huge, dark mountain—the Sinai of Hevelius—whose steep and pointed summit, higher than the lofty Snowdon, shoots upward for above 4,000 feet in sheer precipice from the plain. The centre, this, of the terrible convulsion that once shook the very heart and substance of our satellite; so that it would seem, indeed, that it needed but little more to burst the entire globe, and scatter it into fragments.

The awful character of such scenery is feebly represented by anything terrestrial analogous to it. Were we to seek it anywhere, it would be in the wilds and desolation of Hecla, which, by the following description of a modern lady traveller, it seems to resemble not a little:—

"Suddenly, as if by magic, I found myself standing on the brink of a chasm, into which I could scarcely look without a shudder; involuntarily I thought of Weber's *Freyschütz* and the 'Wolf's Hollow.'

"The scene is the more startling from the circumstance that the traveller approaching Thingvalla in a certain direction sees only the plains beyond the chasm, and has no idea as to its existence. It was a fissure some five or six fathoms broad, but several hundred feet in depth; and we were forced to descend by a small, steep, dangerous path, across large fragments of lava. Colossal blocks of stone, threatening the unhappy wanderer with death and destruction, hang loosely in the form of pyramids and of broken columns, from the lofty walls of lava, which encircle the whole long ravine in the form of a gallery. Speechless, and in anxious suspense, we descend a part of this chasm, hardly daring to look up, much less to give utterance to a single sound, lest the vibration should bring down one of those avalanches of stone, to the teriffic force of which the rocky fragments scattered around bear ample testimony. The distinctness with which echo repeats the softest sounds and the lightest footfall is truly wonderful.

"The appearance presented by the horses, which are allowed to come down the ravine after their masters have descended, is most peculiar. One could fancy they were clinging to the walls of rock.

"This ravine is known by the name of Almanagiau. Its entire length is about a mile, but a small portion only can be traversed; the rest is blocked up by masses of lava heaped one upon the other. On the right hand, the rocky wall opens, and forms an outlet, over formidable masses of lava, into the beautiful valley of Thingvalla. I could have fancied that I wandered through the depths of a crater, which had piled itself these stupendous barriers during a mighty eruption in times long gone by.

"My pen is unfortunately too feeble to bring vividly

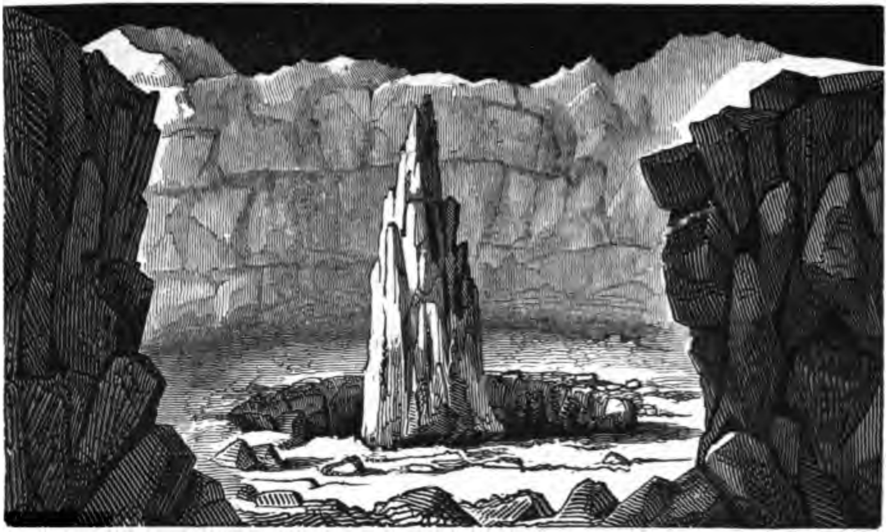

Plate VI.] **LUNAR CRATER.**

before my readers the picture as I beheld it here, and to describe to them the desolation, the extent and height of these lava-masses. I seemed to stand in a crater, and the whole country appeared only a burnt-out fire. Here lava was piled up in steep inaccessible mountains; there stony rivers, whose length and breadth seemed immeasurable, filled the once verdant fields. Everything was jumbled together, and yet the course of the last eruption could be distinctly traced.

"I stood there, in the centre of horrible precipices, eaves, streams, valleys, and mountains, and scarcely comprehend how it was possible to penetrate so far, and was overcome with terror at the thought which involuntarily obtruded itself—the possibility of never finding my way again out of these terrible labyrinths."—*Madame Pfeiffer's Journey to Iceland.*

Copernicus, although another of the radiating craters, does not show such disturbance; and there is nothing softer or calmer in the scenery of the moon than this crater exhibits, whose bright and branching rays (some of them nearly ten miles in width) shoot out on every side, over the pearly surface of the plain, undisturbed by any commotion comparatively. When the moon is in the first quarter, nothing can be more beautiful than the lights and shadows of the rocky cliffs and walls exhibited by this crater.

The perfectly circular shape, to which we have already referred as the type of the lunar craters, has been attempted to be accounted for by Robert Hooke, the celebrated English mathematician and natural philosopher of the seventeenth century, who, in a work of his entitled "Micographia," published in 1665, put forward the theory of the reaction of the interior of the moon against the exterior, or the effect of subterranean fire and elastic vapour, breaking forth, even to *ebullition*, and sending up to the surface bubbles, or blisters. Accordingly he made several experiments, by boiling thick calcareous solutions, which, he says, produced similar formations to the lunar craters, as they rose and hardened upon the surface.*

There *are* a few places upon the earth where something much resembling them in shape is to be found.† Indeed, Gallileo himself, as Humboldt declares, had been reminded, by a circular wall-surrounded plain in the moon, of the configuration of entire countries, such as the great closed basin of Bohemia, which might be compared to lunar craters of the largest diameter, of which there are two or three; but these, with most of those that cover her surface, are considered more likely to be craters of elevation, *without continuous eruption*, as many of those on our own planet with which we are acquainted.

There are, however, advocates still for the present activity of lunar volcanoes, and mysterious changes are said to have taken place, and fires to have been observed, upon the face of our placid luminary; which, if correct, would lead to the notion that, peaceful as she appears to us, all was not yet at rest in that disquieted globe.

Thus Sir W. Herschel writes, in 1787, April 19th, 10h. 36m.:—"I perceive three volcanoes in different places of the dark part of the new moon. Two of them are already nearly ex-

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* Appendix D. † Appendix E.

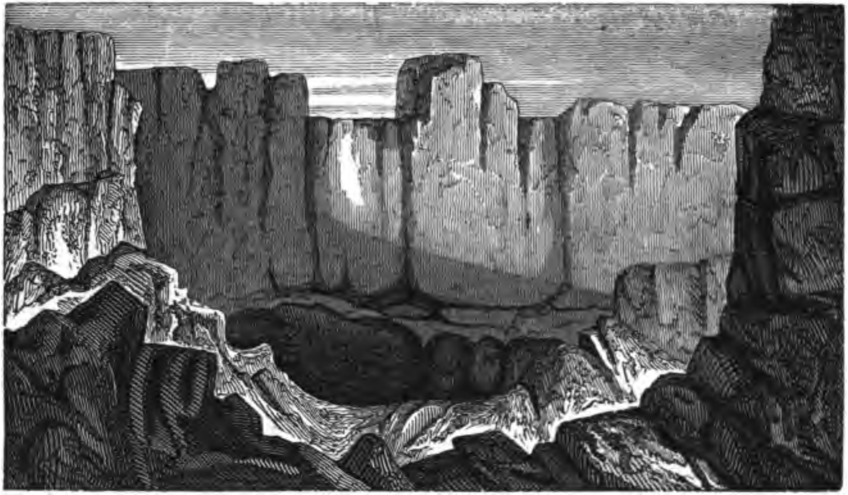

Plate VII.] INTERIOR OF TRUKKEE, AN EXTINCT CRATER IN THE CUTCHEE HILLS (INDIA.)

tinct, or otherwise in a state of going to break out; the third shows an eruption of fire or luminous matter." And again, on the next night, April 20th, 10h.:—"The volcano burns with greater violence than last night; its diameter cannot be less than 3″, and hence the shining or burning matter must be above three miles in diameter. The appearance resembles a small piece of burning charcoal, when it is covered by a very thin coat of white ashes; and it has a degree of brightness about as strong as that with which such a coal would be seen to glow in faint daylight." The foregoing observations led Sir W. Herschel, who at the time was in possession of better instruments than any man living to enable him to determine the fact, to embrace fully the theory of continued activity in the lunar volcanoes, particularly as he saw, or thought he saw, a confirmation of it in the accumulation of matter, not before remarked, as soon as the supposed eruption had ceased.

To this may be added the observations of the celebrated Schrœter, of Lilienthall, the most persevering and eagle-eyed of astronomers, who, in the Transactions of the Society of Natural Philosophy, at Berlin, thus relates, that on the 30th of December, 1791, at five o'clock, p.m., with a seven-feet reflector, magnifying 161 times, he perceived the commencement of a small crater on the south-west declivity of the volcanic mountain in the Mare Crisium (marked U in the map), having a shadow of at least 2″ 5′. On the 11th of January, at twenty minutes past five, on looking at their place again, he could see neither the new crater nor its shadow. Again, on the 4th of January, 1772, he perceived on the eastern crater of Helicon, a central mountain of a clear grey colour, 3′ in diameter, of which, *during many years' observations, he had perceived no trace.* This appearance, he adds, is remarkable, as probably from the time of Hevelius the western part of Helicon has been forming into its present shape, and nature seems in that district to be particularly active.

It is, perhaps, premature to dispose of these important observations and remarks of the two most eminent astronomers in the world as summarily as more recent observers have done, and to explain them away altogether, as referrible to illusions produced by the reflective nature of the lunar soil, seen by earth-light, reflected from the tops of mountains, at various angles. It is true, indeed, that such an explanation may in some measure account for the apparent activity of the volcano seen by Sir W. Herschel, which, by a careful comparison with similar observations of others since then, seems to point to the same spot, where a mountain called Aristarchus is to be seen, with a top at times strangely luminous, though variable, but always more brilliant than others — so much so as to be known familiarly as the brightest spot on the moon. This I have frequently seen myself; and when the atmosphere has been in a state of undulation, a vivid motion has been communicated to that spot, bearing a strong resemblance to a volcano in activity; while at other times, when the air has been calm and still, it has shone with a steady, clear phosphoric light.

The observations, however, of Schrœter, with reference to the changes he observed, cannot so readily be explained; and there is nothing improbable in his account to lead us to reject the notion, that in a world so torn by volcanic forces, some great changes, such as he remarked, should still be going on.

But if the moon be peculiar in the formation of her mountains, she is even more so in two other particulars—viz., atmosphere and water. The absence of either of these essentials to a human habitation implies the absence of the other—*i.e.*, if there be no water, there can be no atmosphere such as ours; and if there be no atmosphere such as ours, there can be no water. A fluid there *may* be, and an atmosphere there *may* be, in that strange globe; but that fluid cannot be water, that atmosphere cannot be the air we breathe. If the present pressure of our atmosphere were removed from our lakes and seas, the water would boil at a temperature of 72, and go off in vapour. Now, as it may be safely presumed that the same causes will produce the same effects everywhere, if there were water in the moon without atmosphere, or with so little as to amount almost to a vacuum (which is the general opinion), precisely the same effects would follow ; and the lunar rivers, or rills, or lakes, or seas, exposed as they are to the intense heat of a vertical sun for fourteen nightless days, would not long remain there, but would be immediately dissipated. On the other hand, an atmosphere such as ours without water, or, having water, without clouds, would be an equal impossibility. But not the slightest vestige of either clouds or water have ever been seen.

That an atmosphere of *some kind* may exist, is not denied; and although the weight of evidence seems against it, Schrœter and some others affirm the great probability of its existence, although they acknowledge it must be of small extent, and of so great rarity as to amount almost to a vacuum.

The tests that have been most relied upon, as indicating the presence or absence of atmosphere, are two—first, the occultation of a star; and second, twilight.

The occultation of a star by the moon, is the passing of the moon between us and a star. On such occasions it was rightly conjectured, that if an atmospheric envelope such as ours existed round our satellite, the star would not disappear suddenly; but, by the law of atmospheric refraction, would dwell, or hang a little on the edge or surface of the moon, as though it were passing between us and her, instead of behind her, and then, gradually, and not instantaneously disappear.

Now, it is a curious circumstance, that this test, simple and clear as it may appear, has proved wholly inconclusive and unsatisfactory, from the fact, that *both* conditions have been strictly fulfilled, not only as seen by different observers, at different times (which might lead to the conclusion that there was an atmosphere, but that it was variable in density), but by *different observers*, on *precisely the same occasion, and at precisely the same moment;* which puts such a supposition out of the question. The attention of astronomers had been long called to the fact of the different experience of observers in relation to this matter; some of whom had always remarked the instantaneous disappearance of the star, others, on the contrary, had *occasionally* observed the star to hang apparently upon the surface of the moon, after contact with the edge, and even to advance considerably upon it, as though it were about to cross the face of the moon, as Venus and Mercury do the disc of the sun in transit. Some of the stars, likewise, were observed to alter their colour during this phenomenon. As this could be explained by the refraction of an atmosphere, the particular attention of astronomers was invited to it by the Royal Astronomical Society; and, with the idea of deciding the question finally, simultaneous observations of the occultation of the Red-Star, Aldebaran, were determined upon throughout a great part of Europe; but with this curious result, as may be found in the fourth volume of their memoirs:—"Some, who had not seen the last-mentioned phenomenon, now saw it for the first time; others, who had seen it before, did not see it; some who had never seen it before continued unable to do so. Of six observers at the Royal Observatory, five distinctly saw the projection of the star on the moon's limb; and one saw it hang on the edge of the moon, five or six seconds before it disappeared. Of three at the Observatory of Paris, two distinctly saw the projection, and one saw the star disappear instantaneously, leaving a shade on the part of the moon at which it disappeared. The majority saw the star either projected or hanging on the moon's edge. Thus, the test adopted, instead of deciding the matter, left it involved in deeper obscurity; and it is now considered, with much probability, that the phenomenon alluded to is to be accounted for much nearer home, and to be attributed, if not to the telescope in the astronomer's *hand*, to *that* which is placed in his head; and that it is caused by some optical illusion not yet fully explained, in connexion with the retina of the eye, upon which the image of the star is painted.

The second test is twilight. This, which we know to be the effect of atmosphere in our own planet, and can readily be discerned in Venus, would afford, it might be thought, a more satisfactory test. But here again astronomers are at fault, some distinctly perceiving it, or thinking they perceive it, while others have never been so fortunate. Among the foremost of the former Mr. Schrœter is, of course, to be found, who, on various occasions, affirms that he saw a faint grey light, of a pyramidal form, extending from the moon's cusps into the dark hemisphere, which, assuming it to be the moon's twilight, must necessarily imply the existence of an atmosphere. His conclusions upon this observation are, that the more dense parts of this atmosphere are about 1,500 feet high; and that the height of the atmosphere, where it could affect the brightness of a fixed star, or inflect the solar rays, does not exceed 5,742 feet, or about an English mile. Now, a fixed star will pass over this space in less than two seconds of time; and if it emerge at a part of the moon where there is a ridge of high mountains, scarcely any obscuration could take place that could be perceived.

The evidence for an atmosphere derived from this source (it can be plainly seen) would depend altogether upon the correctness of the observation; and, taking into account the unaccountable imperfections of telescopes, especially in former days, and the great variety of effects produced by the state of our atmosphere, the evidence of Schrœter — important and interesting as it is—does not seem sufficient to establish, beyond all question, the existence of an atmosphere.

And now, what a wonderful place we have been exploring. How different the impression left by a close survey of her scenery and a distant view of her mild radiance. The moon of the astronomer, we see plainly, is not the moon we are acquainted with. One glance through his magic tube, and all is changed, as by the touch of an enchanter's wand : the fairy-land of the imagination dissolves; and, in its place, leaves us a dreary solitude. The imagination, which ever loves to speculate where certainty is difficult or impossible, has frequently peopled our attendant satellite with myriads of intelligent and joyous inhabitants; has clothed her landscapes with a more than earthly beauty and verdure, and represented her — as the lovely face she presents to our unassisted vision, and the softened splendour of the beams we admire, might naturally suggest—as the perfection of an earthly paradise. No part of creation, say those who reason thus, is likely to be unpeopled ; and it is not consistent with the wisdom and benevolence of God to suppose an empty waste, without an inhabitant, in any part of his dominions. *Therefore* the moon must be inhabited ; her mountains are more lofty and magnificent than ours, and her vales covered with vegetation, and arrayed in all the loveliness of terrestrial glory. Yet, what are the facts ?—what evidence have we for such a supposition. Not a shadow of well-grounded proof, after the many years of close and searching scrutiny directed to the surface of our satellite. Without water, without air — what forms, either in the vegetable or animal world, analogous to ours, could exist; no change or movement of the slightest kind perceptible there, presenting always the same unvarying picture of arid desolation, undimmed by a solitary cloud, unrelieved or undisturbed by a passing shadow? From the top of her loftiest mountain to the extremities of her widest plain, ever the same—a picture of glittering solitude by day, and ghastly gloom by night; with a climate alternating every fortnight with the heat of the African desert and the cold of Spitzbergen—what are we to think?—That the reasoning that would indulge in the perfect analogy of the moon to the present condition of our globe is unsound, as it is improbable. "One star," it is said, "differeth from another star in glory." This is true, as well with respect to its physical condition as its external appearance. Who that knows anything of the past history of the earth, as it is now revealed by geology, does not see the perfect consistency of a desert state—a state of emptiness and desolation—as one of the periods in the ever-advancing and progressive history of creation; especially as it is shown in the only planetary body that admits of demonstrative proof, in reference to this point? Indeed, had geology borne no testimony to this truth, the 2nd verse of Genesis would, where it is stated that the earth was without form, and void, and was completely submerged with water, and enveloped in darkness. There was a time, then, when the round globe we inhabit was as utterly destitute of, and unfit for, a human inhabitant, as we believe the moon now to be of forms analogous to our own in *any respect;* but as a gradual unfolding and development of animal life is plainly perceptible in the geological strata of the earth, so it may possibly be with the moon. The cradle for future inhabitants it may be; over those dark plains waves may yet roll, and billows play; over those sterile wastes verdure may yet extend, till it blossom as the rose; the fresh breeze may yet fan the lofty mountain-tops, and wave the green branches of her forests; and her sky may yet be a heaven of blue and gold, and her soil and atmosphere alike teem with life, while over her solitary wastes myriads of inhabitants may yet roam. But, in the meantime, all there is silent and calm, lifeless and dead, as the grave.

This does not, however, destroy altogether the interest connected with her, although it may rob her of much that excites the imagination; on the contrary, it addresses the mind to a different, but surely not less interesting, view of the subject. It directs us at once to the present great and obvious intention of the Creator in placing the moon *where* it is, and making it *what* it is. The greater the desolation, the more obvious the single intention. It is for *us*, then, and *us specially*, it was intended; for this she was placed where she is, to be a lamp and regulator for the earth. It matters not, then, of what she is composed, so as this end is accomplished—only so as she does the work for us, it matters not whether she is an empty waste or a populous sphere—if she was nothing but a volcanic mass of rock, or huge fragment of this, the parent planet, thrown off, according to the beautiful and ingenious theory of La Place, as a condensed portion of a ring of the earth when in a fluid state—however formed, or of whatever material composed, or however arranged physically and internally, so as she complied perfectly with the condition imposed upon her, and fulfilled the gracious design of the Heavenly Architect, who planted her in the heavens, and bade her circulate and shine there for our benefit; it matters not—she should be, and is as much an object for admiration, and wonder, and gratitude, for those for whose advantage she is placed there, as if she were herself the most perfect paradise upon which the Almighty ever lavished his surpassing skill, and wisdom, and glory.

In considering these matters, then, let us take a few thoughts that suggest themselves in immediate connexion with this view; and possibly we may find some compensation for the dreary journey we have gone, or the disappointment that may be felt by finding the day-dreams of our imagination melt away under our close scrutiny.

There are two classes of suggestions that offer themselves — the first, relating to her utility; the second, to her beauty. The first showing the substantial benefits she confers as our satellite, and the second the impression she makes—the entire displaying the wisdom that gave us a satellite, and the love that made her what she is to us.

CHAPTER IV.

Utility and Beauty of our Satellite—Use and Advantage of Lighting by Moons—Proofs of Design—Refutation of La Place's Objection.

THE first of the substantial benefits the moon confers upon us is her light; and here we may remark, that of all the modes which the Almighty Architect of the universe has devised for carrying into effect His designs of wisdom, and benevolence, and utility, in the best manner to display His glory, there is none that can exceed that by which it has pleased Him to illumine our nights, and not ours only, but those of other worlds, in this respect, at all events, analogous to our own.

It is a well-established fact, that the earth is one only of a number of planetary bodies, whose nights are thus relieved and cheered by moons, *i.e.*, by planetary satellites or attendants, acting as reflectors (not originators of light), and differing in number and in size, according to the magnitude of the primary planet, and in proportion to its distance from the sun. Thus, while Mercury and Venus, from their proximity to that body in whose beams they bask, need none, the Earth possesses one, Jupiter four, Saturn eight, Uranus six (as yet discovered), but probably more. Contrivance and intention are here evident, as in the case of the light-houses that cast their friendly beams, from polished mirrors, over the dark waste of water, for the benefit of those who are out upon its surface. The moon, too, is a reflector (though not a polished one, which would not answer the purpose), and casts the solar beams which she receives, through the darkness of space, for the benefit of those upon earth, during the period when it is required most; the intention is not so much to remove altogether as to interrupt the darkness, and the contrivance is to do it by reflection. What power and skill has been employed to effect this apparently simple arrangement, we can have little notion of even after a thorough acquaintance with the complicated movements of our satellite round her primary, and the various duties that she discharges; but merely viewing it with reference to the provision for lighting the earth by a moon, what do we find?—The sun has first darted forth his beams, at the rate of 190,000 miles in a second, through more than 96,000,000 of miles of space, in eight minutes; it has struck the rough surface of our satellite, an opaque body, not bigger, when compared to the sun, than a grain of the smallest shot would be to a globe two feet in diameter, and from thence it has rebounded 240,000 miles back again to the earth, to scatter a shower of silver light—to pour a flood of midnight radiance and glory over the landscape; and, as she sweeps along over the surface, to cause a series of dioramic pictures of beauty to fall on sea and land, on mountain and vale, on lake and tower, and woodland scene. Thus viewed, how beautifully the designs of wisdom and utility are carried out — how plainly the benevolent intention is apparent in the contrivance. The moon is but a beauteous mirror of the sun, placed where she is by the Divine hand, and for the express and obvious purpose of our benefit. As such, she is a mirror of His own love and wisdom, like the blessed Book He has given us — a reflection of His glory—which "he who runs may read;" or, like that greatest and best gift of His love, so truly and beautifully described by the Apostle, who says—"God, who commanded the light to shine out of darkness, hath shined in our hearts, to give the light of the knowledge of the glory of God, in the FACE of Jesus Christ."—2nd Cor. iv. 6. But lighting the world by reflection at night is in itself a proof of what may be called benevolent forethought. It does not seem that any other mode would effect the object as well or as agreeably. Self-generating light, directly-communicated, like that of the sun by day, would, as we know, produce *heat* as well as light; but this would be injurious to human life, as well as painful to the sight. Night is the period for the temperature to fall, by the temporary absence of our great luminary, by which nicely-adjusted atmospheric balance an even temperature is sustained, and man is relieved from the burning heat of the day; but were the moon even a small sun, the temperature would be sustained all night, and the atmosphere would soon attain such an accumulation of heat, and rarefaction, as to be unfit to breathe.

By the simple arrangement of light by *reflection* at night, when no *perceptible** heat is transmitted from the lunar rays, we are preserved from this danger; but the moon is, and must be, as a reflector, not only a lesser light than the sun in magnitude, but a lesser light in intensity than if she was herself a sun; and the intention is plain, viz., to relieve the eyes from the glare and brilliancy of the greater light, which, if continued, would be painful in the extreme. Man, it is true, is formed for repose, and night is the season for it, when the eyes are generally closed in slumber; but the activity of his mind is such, that there is no night that does not find many millions awake—travellers by sea and land; when the lunar beams are not only useful but delightful, from the change in their character, by which the eye is relieved; and accordingly a light is provided for him without dazzling, and as unlike daylight as possible —a light which shall be sufficiently clear to enable him to discern every object, and to avoid danger, while it is so mild in its lustre, that the eye can never be pained by it, but, on the contrary, is refreshed and delighted: thus comfort is combined with utility in the conveyance of light to our planet, and the designs of omnipotent and heavenly wisdom are carried out in such a manner, as to give pleasure while they confer a substantial benefit.

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* *Vide* Appendix F.

The careless, and the thoughtless, and the worldly, it is true, may not see this nor value it, and the inhabitants of a large city may not miss her light, in these days of artificial illumination, when, as the sun goes down, the glare of ten thousand lamps supplies her place, or vies with her light, leaving our modest luminary only as an object of curiosity or admiration;

but numbers of the wild tribes of men and nations of the earth are, notwithstanding, still dependent upon her altogether, while her light is of unspeakable value to individuals and families in districts and places on earth, remote from cities—from the sailor on the wide ocean, to the poor traveller on the dreary moor or in the wild forest. But what a protection her light is even now; night is the time when the wicked are at work, and the robber and the murderer carry on their dreadful trade. We can form but little idea, in the present days of artificial moonlight, and in the civilised portions of the world, what a protection her light affords. In London, even within the recollection of the writer, there was the greatest difference in the amount of danger or risk in walking the streets on moonlight nights, and those intervals of her short absence, when a few miserable twinkling oil lamps made darkness visible. Her value could not be better shown indeed than by the contrivances to supply her place during a former period. Read the following, from Mr. Macaulay's "History of England," on the state of London in the days of the Second Charles:—

> "When the evening closed in, the difficulty and danger of walking about London became serious indeed. The garret windows were opened, and pails were emptied, with little regard to those who were passing below. Falls, bruises, and broken bones were of constant occurrence. For, till the last year of the reign of Charles II., most of the streets were left in profound darkness. Thieves and robbers plied their trade with impunity. There was an Act of Common Council which provided that more than a thousand watchmen should be constantly on the alert in the city, from sun-

set to sunrise, and that every inhabitant should take his turn of duty. But this Act was negligently executed. Few of those who were summoned left their homes; and those few generally found it more agreeable to tipple in alehouses than to pace the streets.

"But, in the last year of the reign of Charles II., began a great change in the police of London, a change which has, perhaps, added as much to the happiness of the body of the people as revolutions of much greater fame. An ingenious projector, named Edward Heming, obtained letters patent, conveying to him, for a term of years, the exclusive right of lighting up London. He undertook, for a moderate consideration, to place a light before every tenth door, on *moonless nights*, from Michaelmas to Lady Day, and from six to twelve of the clock. Those who now see the capital all the year round, from dusk to dawn, blazing with a splendour compared with which the illuminations for La Hogue and Blenheim would have looked pale, may perhaps smile to think of Heming's lanterns, which glimmered feebly before one house in ten during a small part of one night in three. But such was not the feeling of his contemporaries. His scheme was enthusiastically applauded, and furiously attacked. The friends of improvement extolled him as the greatest of all the benefactors of his city. What, they asked, were the boasted inventions of Archimedes, when compared with the achievement of the man who had turned the nocturnal shades into noon day? In spite of these eloquent eulogies the cause of darkness was not left undefended. There were fools in that age who opposed the introduction of what was called the new light as strenuously as fools in our age have opposed the introduction of vaccination and railroads; as strenuously as the fools of an age anterior to the dawn of history, doubtless, opposed the introduction of the plough and of alphabetical writing. Many years after the date of Heming's patent there were extensive districts in which no lamp was seen."

It is true that the infidel astronomer and philosopher, La Place, endeavours to destroy its value, and to argue against the gracious intention, by the fact of the temporary absence or invisibility of our satellite. Some partisans, he says, of final causes, have imagined that the moon was given to the earth to afford light during the night; and he says, "this cannot be, as we are often deprived of the light of both sun and moon at the same time," and then suggests the inquiry why the moon should not be always full, if intended to give light; and proposes a plan by which the great Architect of the universe might have accomplished this, for instance, that the moon might have been placed at such a distance beyond the earth, that her periods would harmonise with ours, and thus always present a full face to us. The answer to this is so admirably put by Professor Whewell that it will be only necessary to quote it:—

> "That the light the moon affords is, *to a certain extent*, a supplement to the light of the sun, will hardly be denied. If we take man in a condition in which he uses artificial light scantily only, or not at all, there can be no doubt that the moonlight nights are for him a very important addition to the time of daylight. And as a small proportion only of the whole number of nights is without some portion of moonlight, the fact that sometimes both luminaries are invisible very little diminishes the value of this advantage. Why we have not more moonlight, either in duration or in quantity, is an inquiry which a philosopher could hardly be tempted to enter upon, by any success which has attended previous speculations of a similar nature. Why should not the moon be ten times as large as she is? Why should not the pupil of man's eye be ten times as large as it is, so as to receive more of the light which

does arrive? We do not conceive that our inability to answer the latter question prevents our knowing that the eye was made for seeing: nor does our inability to answer the former, disturb our persuasion that the moon was made to give light upon the earth.

"La Place suggests that if the moon had been placed at a certain distance beyond the earth, it would have revolved about the sun in the same time as the earth does, and would have always presented to us a full moon. For this purpose it must have been about four times as far from us as it really is; and would therefore, other things remaining unchanged, have only been one *sixteenth* as large to the eye as our present full moon. We shall not dwell on the discussion of this suggestion, for the reason just intimated. But we may observe that in such a system as La Place proposes, it is not yet proved, we believe, that the arrangement would be stable, under the influence of the disturbing forces. And we may add that such an arrangement, in which the motion of one body has a *co-ordinate* reference to two others, as the motion of the moon, on this hypothesis, would have to the sun and the earth, neither motion being subordinate to the other, is contrary to the whole known analogy of cosmical phenomena, and therefore has no claim to our notice as a subject of discussion."

With reference to Mars, as an exception to the Divine arrangement of lighting by satellite reflection, we have the following from the same writer:—

"Mars is a more obvious exception. Some persons might conjecture from this case, that the arrangement itself, like other useful arrangements, has been brought about by some wider law which we have not yet detected. But whether or not we entertain such a guess (it can be nothing more), we see in other parts of creation, so many examples of apparent exceptions to rules, which are afterwards found to be capable of explanation, or to be provided for by particular contrivances, that no one, familiar with such contemplations, will, by one anomaly, be driven from the persuasion that the end which the arrangements of the satellites seem suited to answer is really one of the ends of their creation."—*Whewell's Bridgewater Treatise*, *p.* 178.

CHAPTER V.

The Moon considered as a Satellite—Her Movements in Space—Proofs of Design—Lunar Perturbations—Real and Apparent Motion—Phases—The Moon a Magnet.

BUT the giving of her light is not the only substantial benefit we derive from the moon, nor the only indication of the gracious design of love apparent in the matter; the arrangements by which she accompanies us in our journey—or the circumstances connected with her being our satellite, are even more conclusive. Her motions in space, and indeed the motions of all the satellites, are peculiar, and no other arrangement would seem to fulfil the conditions required so well.

Satellites are small planets attached to the larger ones, called their primaries, in the same way, and by the same great law that attaches us to *our* primary, as we and the other planets are carried round the sun, so the satellites are carried round us; but as we are moving *on* in our great orbit, while they move *round us* in their smaller orbit, they must, necessarily, partake of both motions, viz., *ours round* our great luminary, and their own *round us;* hence they never leave us (their primary), but accompany us in our journey as our constant servants and attendants, *onward* in the vast arc of space, *with* us, and *round,* in the comparatively minute circle by which they engird us.

With respect to our own satellite, simple as the arrangement may seem, the exquisite adjustment and balancing of powers, in order to produce the effects required, is such as not only to fill us with astonishment and admiration, but to assure us as plainly as any piece of workmanship made by human hands can testify, to the working of an intelligent mind for our special benefit, whose Almighty power, and wisdom, and skill, combined in the performance of it, are only to be equalled by the love that has planned it. To say nothing of the wondrous spectacle of a globular lamp provided for us, 6,000 miles in circumference, which shall always bear us company, and be bound to us by an invisible cord; to circulate continually around us, and in such a manner that, though varying her distance from us frequently, and deviating from her path considerably, she shall never advance too near us, nor retire too far from us, nor, finally, abandon us. Not to remark upon the prodigious journey she must accomplish in order to supply our want, having an independent task of her own to perform round us of about a million and a-half of miles every month, at the rate of 2,000 miles an hour, while she is at the same time carried forward with us in our vast orbit of six hundred millions of miles round the sun, at the rate of 68,000 miles an hour, making in one revolution a lunar journey, annually, of 618,000,000 miles. Not to dwell upon this: the position of the moon in the heavens, and her motions through space in order to produce the beautiful and useful effects we are familiar with, evince a system as admirable in contrivance as it is extraordinary in its working; the perturbations indeed of our satellite, produced by the relative attractions of the sun and earth, form the most complicated and difficult problems in astronomy, and opened an extensive field for mathematical study and investigation, so much so that it is only very recently that every difficulty has been overcome, and a perfect knowledge of lunary motions attained—a task as creditable in the acquirement of it, as it was laborious to those who were engaged in it.*

To give some idea of this: the irregularities of the moon's motions have been divided by astronomers into no less a number than sixty; and although some of them are so slight as to be imperceptible, and therefore not usually taken into account, yet there are about thirty that are generally calculated, without considering which, indeed, no degree of mathematical accuracy in ascertaining the moon's position can be attained.

Of, these, I shall only mention a very few, and those the most common, and familiar, and important — not discussing them mathematically, which is not the object of this little work, but popularly and practically with reference chiefly to the effect produced, and the design apparent in it.

A reviewal, then, of the system, included in the lunar orbit, reveals the great Newtonian law of gravitation in full and active working, by an extraordinary system of perturbation and mutual attraction between the three bodies in question, viz., the sun, earth, and moon, which for simplicity and sublimity in results, is incomparable; while, for complicity of detail, it might be compared to the most intricate piece of machinery—the moving power of which, instead of steam, with its hundred wheels, and cogs, and springs, consisted of various magnets, placed in different parts of the works, whose dial told off with mathematical precision, not the hour, but the months; so in like manner, the silvery dial of our lunar clock reads off for us in the blue sky above, by just such a perfectly arranged system of attraction and gravitating machinery, every month that passes; but comparatively few, indeed, are aware that anything of the kind is necessary in order to bring this about, and fewer still, if they were, could comprehend it fully.

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* *Vide* Appendix G.

But with reference to the ordinary phenomena of the moon, with which all are familiar, the real motion of the moon in space may be classed among the first. When we look at her in the heavens, she seems to be travelling rapidly from east to west. This is a deception; her movement is exactly the opposite way, and instead of travelling, as the sun seems to do, from east to west, she is travelling along at 2,000 miles an hour from west to east —yes; it is only the huge old weary earth, as it lurches round on its axis from west to east, that overtakes her in the heavens, and as it whirls each point of its surface past her, makes her seem to rise in the east and set in the west. This is easily proved by watching the moon, with reference to the stars in her neighbourhood. Some fine evening when you are thinking of anything else perhaps, you raise your eyes, and, suddenly you perceive a pale and slender silvery crescent in the west, just as the sun is going down—it is the new moon. But which way is she voyaging? She has just showed her pale face over the western horizon, from which she is hurrying as fast as she can speed; but, all in vain, the earth, ponderous as it is, is too quick for her. In a little time she is overtaken by our western horizon, into which she drops like a snow-flake, *with the stars among which she seems located*, and we see no more of her for that night. But now watch again the second night; there she is still, and something larger—the bright side towards the sun and the west, her horns turned to the east, but she is further from the west than the night before. But *where are her neighbours the stars, among which she was?* They are some way behind her. On sweeps the dark line of the earth's horizon as before; down go her glittering companions of the former night, but she is not among them now—she is not yet gone herself; they have plunged into the horizon before her, and she has gained that much on her pursuer; but still on it rolls, and now once more she is gone for the night—and so it proceeds. The next night our fickle luminary has left the stars, in whose company she was last night, and looks for new acquaintances in the east, towards which she is hurrying on her way rapidly, till overtaken by her pursuing enemy behind her; at last, however, she has gained the victory apparently. To-night she has absolutely reached the eastern horizon, nay, she has got below it, and now two horizons must sweep past her—the first to make her rise in beauty in the east, the second to make her set in glory in the west. But still she pursues her unseen path below the east. Later and later she rises every night; at length we see her no more, except at sunrise in the morning, as a slender crescent—and now even this fades and disappears, swallowed up in the solar glory, till, in a day or two, on raising our eyes to the heavens, there, in the west, the same pale, lovely, silvery object meets our gaze in precisely the same position as we saw her at first. And what does she say to us ?—Since last you saw me here, a month has rolled away.

But while this has been going on, many changes have taken place in the appearance of our satellite. Starting from her conjunction with the sun, until she returns to him again in her progress through the intermediate points, or at quadratures, as they are called, the illuminated part varies according to her position. No figure on paper can convey to the mind so well the nature and cause of these changes as passing an apple or a small globe of plaster of Paris* round a candle, when every phase, or change of the moon, will be exhibited to perfection.

These phases, or different appearances of the moon, have been used in popular language to designate what is called the moon's age, or her quarters, as they are set forth in the almanacs; the orbit she describes round the earth being supposed to be a circle of 360°, divided into equal arcs of 90° each. When she has completed the first 90° from conjunction with the sun, she is in her first quarter, as it is termed, and presents herself as a half moon.

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* A globe of plaster of Paris may be made, of two or three inches of diameter (in a few minutes), by turning round rapidly a piece of wire, to represent the axis, upon which a piece of tow has been put, to which the plaster is added gradually till it attains the form of a sphere; the white of the plaster then represents the lunar phases, more like nature.

The next stage of her journey brings her into opposition on the opposite side of the heavens from the sun, when she is full; from that point having now got to the westward of the sun, she having to decline, with her horns reversed, and the light upon the opposite hemisphere, till having reached her declining quadrature, where she is again a half moon, she at length dwindles as before to a thin crescent, seen at sunrise, and at length disappears altogether for about three days, while she is in actual conjunction.

These phases of the moon have been popularly supposed from time immemorial to affect the weather upon earth—it is a question, however, which seems still to remain in obscurity. For although there is nothing at first sight to lead to the supposition that the moon having moved 90° further in her course, which is all that these changes indicate, should produce corresponding changes in our atmosphere; and the experience of Arago, from observations carried on for many years for the purpose of ascertaining it, does not bear out the popular opinion *in the way it is usually held*, yet certain facts have been collected from observation sufficient to show, that it is far from certain that the moon exercises *no* influence upon the terrestrial atmosphere according to the position in which she is with reference to her primary. It is curious enough, indeed, that the result of the evidence which has been collected upon the subject seems to be contrary to the prevailing notions. For instance, it has been found that there is generally more rain during the increase than during the decline of the moon; and the new moon, which is popularly looked to as a kind of index to the weather, has been found by actual observation to be apparently less active, with reference to change, than any of the other phases. It has been found likewise that rain and foul weather are more frequent during the moon's perigee—*i. e.*, when she is nearest to the sun, than when she is in apogee — at her greatest distance. But, after all, why may not that body which we know affects our waters so powerfully affect likewise our atmosphere, and, consequently, our weather — either indirectly through the tides, which under lunar influence, rolling in a huge wave over the surface of our globe, unquestionably causes atmospheric disturbance, or *directly*, by attractive, and electrical, and magnetic influence (now known to be the same thing, and whose powers we find so largely distributed through our atmosphere, that it ought to excite but little wonder at any disturbance that may be created by the approach or relative position of so large a magnet as our satellite.*

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* No one who has directed their attention to this subject will have failed to remark, how closely connected the rising and falling of the wind is with the ebb and flow of the tide. The writer had occasion to notice the cessation of the terrific storm on Christmas Eve last, precisely at the turning of the tide. A similar occurrence, as well as he recollects, took place in January, 1839, and having frequently directed his attention to the same phenomenon, he has seldom found it to fail; it is well known by sailors and fishermen on the coasts.

CHAPTER VI.

Lunar Distances—Her Mass and Density—Orbit—Periods—Axial Rotation—Gravity on her Surface—Effect upon Oceanic Tides—Balancing in Space—Irregularities — Extraordinary Calculations—Astronomical Tables—Beautiful Apportioning of her Light.

THE distance of the moon from the earth, reckoning to the centre of the latter, is 240,000 miles, or, to speak more correctly, her mean distance is 238,650 miles—for her orbit being an ellipse, and not a circle, her distance varies considerably; producing a difference in her proximity or remoteness to us, of 26,000 miles. When she is nearest, she is said to be in perigee; when most distant, in apogee. This distance, although considerable in terrestrial measurements, is absolutely nothing in space, but yet sufficient to produce a sensible difference in the apparent size of her disk, causing her to vary from 33′-32″ to 28′-48″, which is the minimum. The most recent and exact measurement of her real diameter, as measured by Dr. Wickman, makes her 2,162 miles; and from this measurement Mr. Hind assumes the bulk of the moon to be to that of the earth as one to forty-nine —*i.e.*, our globe is equal in magnitude to forty-nine moons; while, according to the same calculation, it would require a million and a-half of such bodies to equal the sun.

The moon performs her journey round the earth (roughly speaking) in a month, but there are no less than five ways of reckoning her revolution known among astronomers. Of these the most common and important are two, which are called her *sidereal* and her *synodical,* or lunar month. The sidereal is her revolution in the heavens, reckoned from a star till she returns to the same star. This is performed in 27 days, 7 hours, 43 minutes. The *lunar* or *synodic* month, with which we are more familiar, is her revolution as it is reckoned from one conjunction with the sun to another. This comprises a period of 29 days, 12 hours, 44 minutes, 2·87″—a longer period than the other. The cause of this difference is to be found in the fact of the moon's motion in space along with the earth; so that, starting from the sun, when she returns to him again in her orbit round us, she will have moved past him, along with the earth, in the meantime; or viewing the matter *apparently,* the sun will have moved away from her, and gained upon her in the course while she is going round us. So that, when she returns to the spot in space from which she started, she will not find the sun there where she left him, but will take more than two days to overtake him in his apparent motion in the ecliptic, which motion, however (it must be borne in mind), is really produced by herself and not by the sun, which, to all his secondaries, is immoveable.

But the great peculiarity in the motion of the moon (and indeed in all the satellites, it is now believed), is her revolution on her own axis. This differs from that of her primary, in the circumstance that her revolution on her axis is performed in the same time that she takes to revolve round the earth—in other words, her axial rotation and orbitual revolution are nearly synchronical. The effect of this is, to cause the moon always to present the same face to the earth while she turns slowly on her own axis, presenting, however, every part of her surface successively to the sun. That this is the consequence of such a motion, can be illustrated by letting a lamp or a candle on a round table represent the sun; let one person, whom we shall call E, represent the earth. Let E stand at a sufficient distance from the table to enable another person, whom we shall call M, to personate the moon. Let M then walk round E, keeping his face constantly and politely towards him, and it will be found that M will have successively presented every part of his person to the lamp, thereby proving that he has revolved completely on his axis. The effect of this motion theoretically is to maintain the stability of the system; but, practically, it produces a curious effect upon the moon's periods and seasons, which separate her in analogy altogether from her primary; it is to make the lunar days and nights equal to fourteen of our days and nights—to cause on the hemisphere, facing the earth, fourteen alternate days of sunlight and earthlight (or moonlight caused by the earth), and, on the opposite hemisphere, similar periods of daylight and starlight. In fact, were there inhabitants on the opposite hemisphere of the moon they would never know of our existence, except they travelled to the horizon next us, when they would see the strange sight of a huge globe right over their head turning slowly and perceptibly on its axis, and presenting successively, when not obscured by clouds, each feature of mountain, island, and continent.

This journey could easily be accomplished indeed by lunar inhabitants, as owing to the diminution of gravity upon her surface, muscular power would be increased sixfold, and a man could walk ten miles an hour with perfect ease to himself, being enabled even to keep up with the rotation of the moon on her axis, so as to live in perpetual sunshine.

But, perhaps, one of the most useful and wonderful arrangements of the moon's position and orbit, is that by which she is a regulator of the oceanic tides of the earth. This subject, it is true, in its detail, rather relates to a consideration of the phenomena of our own planet—and, indeed, is so extensive, as well as interesting, as to deserve a separate treatise; it is, therefore, only referred to here as one of the *many* good offices performed for us by our beautiful attendant, that show a supervision and ordinance of Infinite wisdom for our advantage. Suffice it to say, then, that it is to the moon's influence chiefly that we owe the regulation of the oceanic tides—a matter of such vast importance to us; and that at new and full moon, our satellite acts in conjunction with the sun, by their united attraction (in which, however, the solar influence is but slight, comparatively), to draw up the oceanic waters from the earth on the *side* presented to these luminaries; while, at the same time, they *draw away the earth* from *the waters* on the *opposite hemisphere* (the earth being nearer to them than her waters on that side, and, consequently, subject to stronger attraction). The effect of this is, to create a huge tidal wave on the opposite sides of the earth, viz., that *next* the moon and the sun, and that opposite to them: the first caused by their attracting the waters; the second by their attracting the earth. The effect upon the other two sides or hemispheres of the earth is, to decrease the amount of water, or to draw it away; so, that while it is high water at the two first-named hemispheres, it is low water at the others. But, this is not all; the moon acts independently, and when she is in *quadrature,* or half-way in her orbit between the sun and earth, her attraction operates in opposition to the sun, and the counteracting attraction of the two bodies moderates the effect of the tides all over the globe—producing what is called neap or low tides. This is a mere barren statement of the great principle by which the tides are regulated by the moon—simple enough to understand in its general features, but when examined and analyzed, one of the most difficult problems in astronomy to solve. Indeed, it requires geographical as well as other knowledge to a great amount to arrive at it; for the effects of wind, and local tides and streams must be calculated, involving a perfect network of cause and effect to be unravelled before arriving at precision; but, when arrived at, as it has been, it presents a perfect whole, showing in every part the clear steps of the Divine skill and wisdom for our benefit.

A glance at the ordinary and less complicated balancings of the moon in her journey, will conclude this branch of the subject; and here the progress of our satellite around us may be compared to the course of a good man, pursuing his way against opposing difficulties and obstacles—now drawn aside by this influence; now retarded by that; now urged more swiftly on his way; now deviating a little from his course, but to regain it again; now letting his light shine before men, and now withdrawing it from their view, but still pressing on in the course prescribed: each phase of increasing brightness representing beautifully that path of the just, that shineth more and more brightly unto the perfect day. Or the sun, the earth, and the moon may be compared to a family, of different dispositions, and tempers, and pursuits, who, being of one mind in heavenly matters, have agreed to correct each other's faults mutually, when they are going astray—bringing each peculiar quality, which would counteract the opposite, to bear upon each other through life; and so to run their course that, although to a superficial observer they might, occasionally, appear to be discordant, or to differ in opinion, all would, in reality, be perfect harmony and peace between them. So it is with our satellite in her orbit. Wherever she goes, she meets with some influence at work to hasten or retard her in her onward progress—to make her deviate or return to her former position—in fact, perturbations or disturbances from her companion orbs are on every side of her, and continually operating upon her by their attraction. Yet still she continues on, notwithstanding all, no real or serious deviation occurring—nay, more, all is foreseen, foreknown, pre-determined, and planned in the Divine mind that created her so accurately that, although no iron track marks the road in the viewless æther through which she passes, no foaming wake is left to show her rapid progress, yet it can be traced and measured to a hair's breadth in all its irregularities; nay, with such precision does she move in the course appointed, as to put to shame and fault the finest instruments that human art and science can invent for ascertaining her position, and makes the most skilful and delicate contrivances — even the very spider's web — seem coarse and insufficient; but from the apparent irregularities of her movements, the most perfect law and regularity can be deduced, and the most complete order discovered ascending in a regular scale, that it may descend again to where it set out; and so it is with all the heavenly bodies. A series of perturbations are established between them all, of which it is hard to say which is the most wonderful — the apparent disorder of the disturbance, or the perfect harmony that is the result. But let us look at this matter a little closer.

The moon, although the humble servant of the earth, and apparently under her sole influence, yet acknowledges a superior authority in the sun, to which she is subject in common with her primary, and by whose attraction she is retained in her orbit, independently of her, so that if the earth were annihilated she would still continue to circulate round him as the earth does. This kind of solar influence is common to both planets, and is exerted equally upon them; but the law of gravitation has been so beautifully devised and arranged by the Almighty, that the solar influence is likewise exerted *unequally* upon both bodies according to their relative position—the sun sometimes drawing the moon to himself away from the earth, and sometimes drawing the earth away from the moon—in the former case, when the moon is nearer to him than the earth; in the latter, when the earth is nearer to him than the moon. This result is owing to the celebrated Newtonian law, that the power of gravitation increases with the square of the distance, and, of course, decreases in a similar proportion; consequently, when the moon is in conjunction, or at the same side of the heavens as the sun, she is more powerfully attracted towards him than the earth, and (if not prevented by terrestrial gravitation or attraction, as well as the exquisitely proportioned and adjusted initial velocity, given her when she first rolled from the Creator's hand) would finally abandon the earth, and (in a little more than two months) descend to the sun, to sink like a millstone in his fiery mass.

In like manner, when in opposition, she would (from the same cause) either flee away altogether from us, never to return, or, in five days, rush down upon our heads, and crash, in thunder and ruin, upon our surface. The present arrangement of the law of gravitation, however, is such as to render either catastrophe (so long as that law subsists) impossible; that it ever should have been made at all, indeed, La Place has calculated as being, in the ratio of chances, as eight thousand to one against it; plainly showing thereby the intelligent design of Beneficence towards us. But, so it is, that just in proportion as the solar attraction acts partially upon either body, the mutual attraction they have one to another is diminished; and, *vice versa*, in proportion as his influence is diminished on either, their mutual attraction to each other is increased; just as we might suppose the attachment of two people for each other to be diminished or modified by the presence or absence of a third; or (to use another illustration), in proportion as the *direct* authority of the Queen was exercised or withheld in Ireland, the influence of the Viceroy would be diminished or increased accordingly. But the first great effect of solar perturbation on the moon is to make her orbit an ellipse, or oval, instead of a circle. The longer axis of this ellipse revolves slowly, but continually, and is called the rotation of her aspides, or points of her orbitual axis, which perform their complete revolution in about eight years, during which her apogee and perigee, *i. e.*, her nearest and furthest distance from the earth, change places.

But, looking at the moon under the solar disturbance, we may imagine her as labouring uphill *from* conjunction with the sun, and down hill from opposition to conjunction—for the attraction of the sun over the moon is always two and one-fifth times more than that of the earth over her.

But how, it may be asked, are the catastrophes we have already referred to, to be prevented? Just by the beautiful adjustment and balancing of the three bodies in question mutually attracting and counterpoising each other, according to their position and mass. Thus:—It is the golden rule of the great Newtonian law, that in the case of a body revolving in its orbit, under the influence of the two forces of projection and gravity, supposing the projectile force to remain the same, whatever tends to diminish the force of gravity causes the body to recede from the centre and to approach the tangent of its orbit; and, of course, whatever increases the force of gravity, causes it to approach the centre. Now, when the moon is in conjunction with the sun, the earth acts as a counterpoise on the opposite side, thus diminishing the solar gravity, and, according to the law we have mentioned, causing her to recede towards the tangent of her orbit, thereby preventing her from abandoning us and rushing into the sun, while, at the same time, her velocity being too great to enable her to set up an independent orbit for herself round the great luminary, she recedes gracefully from him, and continues her course round us. On arriving at her ascending quadrative (90° further), where she is side by side, as it were, with the earth in reference to solar distance, the attraction of the sun will act equally upon both, being at the same distance from him, so that were the projectile force removed, both bodies starting together would arrive at the same moment at the sun, while being acted upon equally by him, their mutual attraction would not be disturbed, and they would approach each other on the way; but the moon, having thus arrived at quadrature, and receded considerably from the sun, the solar gravity has diminished, while the terrestrial gravity has increased. Accordingly, continuing her course round the earth, she is shortly in opposition, and the earth now lies between her and the sun; the gravity of the latter, however, having been lessened considerably by her distance from him, while, on the other hand, the power of the earth's attraction is greatly increased by the same law; the joint efforts of both sun and earth here conspire to hold our beauteous companion in her place, and make her submissive to their power. She, accordingly, instead of taking her leave of us, turns kindly round, and smilingly descends to her falling quadrature and conjunction, again to perform her appointed task, as though endued with life and intelligence, and that the words of Scripture respecting the sun were literally true of the moon—viz., she knoweth her going down.

But, besides these ordinary motions in space, there are numerous irregularities, already referred to, all of which must be taken into consideration in ascertaining the moon's place in the heavens with precision. Some of these are real and some apparent—*i. e.*, not arising from the moon's motion, but from ours combined with hers. Some are so delicate as to be scarcely perceptible; others plain enough to be observed; but one and all present a perfect agreement of theory with experience and observation—the discovery of them sometimes originating with the observation, and sometimes with the theory, but presenting so wonderful and beautiful an entire, that the mind is lost in wonder and admiration at contemplating it. Of these, of which there are sixty now ascertained, leaving indeed nothing more to be discovered, and affording the most perfect astronomical tables for lunar observations that could be presented to the mind of man, it would be impossible and, indeed, useless to speak, in a treatise like this; I shall, therefore, only remark upon one or two striking effects, of great importance to our comfort and convenience, which are calculated to show the design of Infinite wisdom and benevolence towards us in reference to utility. Passing by, then, her librations in latitude and longitude, by the former of which she seems to swing round on her polar axis, so as to show a portion of her eastern and western hemisphere, not always visible; and by the latter of which she seems to vibrate, or balance to and fro on her equatorial axis, so as to present alternately a portion of her poles not usually in view. Passing by these, the former of which is caused by her motion on her axis being a *little* faster or slower than her revolution, and the latter by the angle at which she is inclined to the earth, we may remark, that according to the movements we have already described, the new moon will always be found in the same part of the heavens with the sun, and the full moon in the opposite part. So that, as a general rule, it may be remembered that the full moon rises and the new moon always sets at sunset. But the consequence of this arrangement to us is of the greatest importance, for in winter the sun, being in the winter solstice, sets far in the south-west, running very low, and, accordingly, the new moon, that must always bear him company, runs low too; but, for the same reason, the full moon, rising in the opposite side of the heavens, far to the north-east, runs high, as we may remember, in the middle of winter; but, in summer, the case is exactly reversed. The sun runs high, and so do the new moons—but the full moons low. The consequence of all this to us is, that we have the greatest abundance of moonlight when we need it the most, in the depth of winter, through whose long evenings and dreary nights she remains to enlighten and cheer us; while, on the other hand, we have less of her light when we require it least—*i. e.*, in summer, when we have most of sunlight, when the full moon appears but a short time above the horizon, and there is no real night, the sun's last red rays scarcely fading in the west ere they are resumed in the east. But the effect of this arrangement is peculiarly valuable to northern nations, and the inhabitants of the polar regions. There, as we know, they have constant day for many months, and night for a similar period; but, for the same reasons that we have mentioned, no sooner has the sun taken his leave of them than the moon takes his place; and remains constantly upon their horizon during her second and third quarter, when she is brighest and largest; while in summer, when the sun is constantly above the horizon, and lunar light is not needed, she is only in view during her first and last quarter, when she is a mere crescent; but it is only to the polar regions she is such. At the same moment a full moon is lighting up with her splendour those regions of the earth from which the sun is absent.

CHAPTER VII.

Fresh Proofs of Intelligent Design — Benevolent Intention — Harvest Moon—Paley on Astronomy, as a Medium *for* Proving Divine Agency — Comparison with Anatomy and Geology— Lunar Arrangements—Proofs of God's Love to Man.

Now, what are we to think of all this? Is it by chance that it so fell out? and is it only by a happy concurrence of fortuitous atoms that the complicated but beautiful machinery we have described, and the wondrous movements of our satellite, first fell into their present shape and arrangement; and that order, and beauty, and utility thus sprung from disorder, and ruin, and hideous chaos; and light was portioned out successively to every part of our globe, according to its need, with unfailing punctuality, and unerring precision, and provident calculation? Let the sceptic and the materialist ponder upon this, and think if his creed can stand a moment before such a supposition, before the solemn testimony of our satellite against him; let him endeavour to design a machine which shall imitate, ever so imperfectly, the lunar movements in all their parts, and produce the various effects we have mentioned, and he will, even with nature's model before him, find how it will tax his skill and ingenuity to the utmost; but *without* that model, could he have executed or even imagined it? But that blind chance or necessity could have originated such wondrous laws is the last reach of human folly and human presumption to affirm. As rational, indeed, upon such reasoning, would it be to say, that if a son asked his father for bread, it was by chance he did not get a stone; if he asked for a fish, it was by chance he did not get a serpent: for in such a theory there can be no rational connexion between cause and effect—and one might as well happen as another. But in the simple view which Christianity reveals, the very reverse is the fact, and there is no chance at all about it. An intelligent, infinitely wise, and gracious Father is revealed as the solution of the problem—presiding over all, and providing for all according to their need. "Your Heavenly Father," says Jesus, "*knoweth what ye have need of.*" And again—"If ye being evil, *know how* to give good gifts unto your children, *how much more* doth your Heavenly Father *know how* to give *good things* to them that ask him." In this case, indeed, God waits not to be asked—His provident love and kindness has arranged it beforehand. He maketh His sun (and may we not add His moon?) to shine upon the just and upon the unjust—alike the witnesses of the Power which has created them, and the wisdom and love that has devised them. But there is one more beautiful effect, which we must notice—viz., the harvest moon. About the period of the autumnal equinox, any one may remark what a number of bright moonlight evenings we have. These are called, popularly, harvest-moons, because they occur at the time when the harvest is getting in, and her prolonged light is peculiarly seasonable, enabling the labourer to devote extra time to this uncertain but needful work after sunset, and thus secure the crops, Whether this was really the intention of this arrangement, it is impossible to say—but, certainly, it has been so popularly remarked and adopted by most nations,* who from their position on the earth can derive benefit from it.

The following lines of Henry Kirke White, contain a beautiful description of a moonlit harvest scene:—

"Moon of harvest, herald mild
Of plenty, rustic labour's child,
Hail! oh, hail! I greet thy beam,
As soft it trembles o'er the stream,
And gilds the straw-thatch'd hamlet wide,
Where Innocence and Peace reside;
'Tis thou that glad'st with joy the rustic throng,
Promptest the tripping dance, the exhilarating song.

"Moon of harvest, I do love
O'er the uplands now to rove,
While thy modest ray serene
Gilds the wide surrounding scene;
And to watch thee riding high
In the blue vault of the sky,
Where no thin vapour intercepts thy ray,
But in unclouded majesty thou walkest on thy way."

The astronomical cause of this is plain enough, though, perhaps, not so easily explained popularly as other of the lunar motions. It arises from the small angle formed by the moon's path (or the ecliptic, which is nearly the same), at that particular period of the year, with the horizon—the consequence of which is, that the moon has not time to get far below the horizon, and rises for three nights successively before and after "the full" about the same hour—or, at least, not more than twenty minutes later each night; it is true that the very same phenomenon takes place every time the moon is in Pisces or Aries—viz., once a month; but it is only at harvest time that it happens, when she has a full face and, consequently, becomes an object of notice.

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* This would not apply to nations in the neighbourhood of the equator.

And, now, may we not ask, putting aside altogether as unworthy of notice or argument, that ungrateful perversion of mind, called Atheism, which makes "the fool in his heart" say—"There is no God"—may we not safely say, is there not evidence here in the wonderful machinery of the heavens for the most cavilling mind to ponder upon—for the most sceptical to be awakened by—and, we may add, is there not reason for the unfeigned admiration and praise of the Christian? It has been said by Dr. Paley, that "astronomy is not the best medium through which to prove the agency of an Intelligent Creator." This, he says, arises from our want of knowledge of the constitution of the heavenly bodies—both as to their forms and motions—which are not sufficiently known or evident as to be at once apparent to the mind, and to render them adapted, as some other subjects are, to the purpose of argument. This may be the case to a certain extent; since the days of that eminent man, however, our knowledge of the heavenly bodies has greatly increased; and, if it be not the *best* medium, it is certainly not the *worst*—for astronomy stands in a very different position, and that which was confined to a few has now become the property of the many. This difficulty is, therefore, considerably obviated, and, at all events, in the case of the moon and the lunar motions, it may be considered as completely removed; for what machine is there, with which we are better acquainted, or that can be more accurately described, than the wondrous machinery of the lunar motions, although carried on, it is true, without any sensible intermediate apparatus? This, indeed, is unnecessary for the purpose, provided the adaptation of the means to the end can be perceived; and the knowledge of the Newtonian law is quite sufficient to do this—to develop every movement, and lay bare every working of the heavenly engine. "Once convinced," says Dr. Paley, "of the agency of an Intelligent Creator in those movements, and astronomy raises the mind to sublimer views of the Deity than any other subject affords." The intellectual agency which it does reveal, he divides into three—viz., "*choosing*, *determining*, and *regulating*. *Choosing* out of a boundless variety of suppositions, which were equally possible, that which is beneficial; in *determining* what, left to itself, had a thousand chances against conveniency for one in its favour; in *regulating* subjects, as to quality and degree, which by their nature were unlimited with respect to either." Instances of each of these, we trust, have been given in the foregoing short and superficial treatise upon the constitution and movements of our satellite. But we do not ourselves think that there is any science which affords *more* striking proofs, not only of Design and Intelligence in the Creator, but of the existence of those peculiar and more endearing attributes by which we are accustomed to know Him; not only as the God of Nature, but the God of Revelation: not only as God in His works, but God in His word. Nor do we think, that the proofs are less accessible because of the distance and the magnitude of the bodies of the system which is the subject of our study. Indeed, the works of God are all nearly on an equality in this respect—they all need to be examined. Thus, the anatomist holds the mirror of science to himself, and he finds a wonderful system within him: a mighty engine or forcing pump, whose every throb he is momentarily conscious of, but of the nature of which he is ignorant until he examines, and then he finds a labyrinth of rivers and streamlets, whose red and purple currents are propelled with wonderful energy and force through the entire body; he finds a number of valves that open and shut exactly where they should, and at the precise time that they ought; he finds a number of beautiful contrivances, in which the skill and ingenuity of the maker are apparent as in the works of a watch—difficulties met and overcome — natural obstacles occurring to be vanquished—and all with a wisdom that is never set at nought, with a beneficent intention which cannot be mistaken. He finds a number of thread-like fibres, interwoven one with another in apparent confusion to the inexperienced eye, but in real and perfect order, conveying every message as well as sensation along them to and from the mind's audience-chamber with the rapidity of light, like the electric wires that can now conduct human thoughts over land and under sea, to the extremities of the globe on the lightning's wing. He finds these—matter themselves—connected mysteriously with the thing called mind or spirit, which is invisible save by its effects; and the result of all is, to impress the unprejudiced mind with the firm conviction, of design, and skill, and wisdom, and benevolence, without limit. But, if thus the anatomist examines the body and the astronomer the heavens, the geologist moves earth to make out his case; he stirs up the ground beneath him, and searches in its bowels, where he finds as evident records of design in its creation. But so long are the periods that have passed away since its commencement, that he stands amazed, and the hoary earth, for a moment, assumes the garment of eternity—but it is only for a moment: there is a limit even to these periods, long as they have been; nay, there is a commencement of them all, far as he must go back for it, even beyond the powers of his imagination to conceive. In each of the terrestrial strata will be found a great variety of creation, but each confined to its own period, and never intruding upon another — in short, the same order and succession of organic life that may be perceived in a cabinet or museum arranged by human intelligence, and placed in their proper positions by human hands, from the first specimen that is put there to the last. Thus, the very same perfect order and arrangement, but of a different kind, may be discovered here, that is perceptible in the heavens, only in geology (with the exception of volcanic action, respecting which little is known), all is dead, and cold, and motionless, and lifeless as a statue—like the petrified city or forest in the Arabian tale, or like an engine that had performed its task, whose energy had ceased, whose wheels were silent, and whose works were cold.

In this respect, indeed, astronomy is even a more striking evidence—for there, among the bright spheres above, all is activity and motion. Some of that activity is even perceptible to the naked eye and comes under popular observation, as also the perfect order with which it is conducted; but when examined closely, as it may be, as a witness for its Maker, we do not think it can be excelled by any other branch of natural science. In truth, none of the wonderful works of God would seem to be sufficient witnesses of His glory to sinful man, any more than His word, until examined and summoned to the testimony;—the careless eye and irreligious mind perceive nothing—the observant and enlightened, all things. "The works of the Lord are (indeed) great," but they must be "sought out by those that fear Him" before they can be witnesses of His majesty; but when once found in any department of nature, there are few sensations perhaps so delightful, and few employments more profitable than the discovery of each fresh impression of the Creator's hand, or the following up each vestige or footstep of His glory.

But how apparent is His love in the whole lunar scheme! That the entire constitution, as well as every movement of our satellite, had a direct reference to us, to *our* benefit, to *our* comfort, and *our* delight, cannot for a moment be questioned; and how wonderful the thought that, in the creation of such huge masses of matter, as well as in their position and arrangement in the heavens, God had respect to the little creature that moves upon the surface of one of them, not so big proportionally by the thousandth part (when compared to his habitation) as the grain of dust is to the globe upon which it lies! Yet, small as he is, and apparently insignificant, the formation of two planets, with their stupendous primary, had a reference to the movement of an arm or a leg in this minute creature, for were the density of the earth altered, or the force of gravity in any of the three bodies increased or diminished—in fact, were they anything else than what they are, the most strange or disastrous consequences would ensue, and we should be rooted to the ground, unable to move hand or foot, or open an eye, if not crushed to the earth; or we should be in danger, if once off the ground, of never returning again; or, were the attractive power of the moon increased, either by size or proximity, a vast tidal wave would be raised higher than the loftiest mountains, to return in a thundering avalanche of water, and roll as a fearful deluge over the entire globe. But, now, her density and mass accurately weighed, and calculated, and proportioned to her two primaries; her distance measured to a hand's breadth; her position and place in the heavens balanced, and poised, and adjusted, as in a scale; and her course marked out in baseless ether, as no human hand could do on solid ground—her mass and density do their task, and no more: every arm is free, every muscle unimpeded;—her position and course in the heavens do *their* part likewise, bringing continually scenes of changing beauty and variety—while the entire arrangement speaks peace and safety to us;

tides ebb and flow with clock-work regularity, and gently break on silvery strands, or roar in thunder against the craggy rock, or dash in surf upon the pebbly beach, but their mark is alike determined—their line is measured out—and the command of God has gone forth, conveyed and executed by the bright mass of our attendant planet, that, smiling calmly down from her seat on high upon the midnight wave, as though she were an unconcerned spectator, is all the while saying—"Thus far shalt thou come, and no farther." But even the configuration and appearance of the moon testifies the same—that which renders her unfit for a human habitation herself, makes her minister the more to human comfort and delight. Were she a polished mirror, with a perfectly smooth surface, instead of being perforated and rugged with mountains as she is, and spread over with rough inequalities, the light she gives, instead of being extended over her surface, would be confined to one bright part, round which all the rest would be comparatively dark, as the reflection of a candle in a looking-glass or in water, but, now, in consequence of her inequalities, the entire surface is resplendent. Again, had she an atmosphere like our own, and obscured as frequently with clouds as ours, how often would she be invisible when our sky was clear, or rather how seldom would she be visible at all—now hidden from mortal view by *our* clouds, and now by *her own;* but, as it is arranged, her full face is unchangeable as it is lovely.

CHAPTER VIII.

Beauty of our Satellite—Impression produced by it—Worship of the Moon—Idolatry—Insufficiency of its Removal by Philosophy and Science—Study of the Word and Works of God—Natural and Revealed Religion one Science—Superior Importance of Revealed Religion—Value of the Soul—Human Greatness—Powers of the Human Mind—Love of God to Man—The Two Witnesses—The New Heaven and the New Earth—Astronomy as a Study—Man *ισαγγελος*—Man's Final Home.

Few, perhaps, attach much importance to the quality the moon possesses of exciting admiration, or the impression she produces by her beauty, and yet it is worth noticing. If we enter a flower-garden, where colours and tints of every hue and shade of loveliness meet our view, the intention is at once apparent. Whence this array of beauty and variety, if not for man's eye?—the lower animals heed it not. If we look at a lovely landscape, it is the same. Whence all this wondrous arrangement of light and shade, of smiling valley and purple mountain—of wood and rock, and stream and river, and lake and meadow green, producing such a perfect combination of beauty, if not for man?

So we may say of our satellite, which, it must be acknowledged, possesses to perfection that quality which seems to belong to nature, but not to art—of never tiring by repetition. At once the constant theme of the poet's song, and the subject of the painter's study, and the object of our continued observation from our childhood, it is never out of place as an object of admiration, or interest, or striking effect; it never palls upon the taste or wearies to the eye, but presents itself each time in some new aspect of beauty.

Let us recall to our mind any of the calm moonlight scenes with which the memory is stored, and we shall find this to be true; or watch the next opportunity when it may be realised. Stand upon the deck of the lone ship on the wide ocean—see the moon rise majestically, as a vast globe of fire, from her bed, and turn first to gold and then pale to silver, as she mounts on her way; or float, on a summer evening, on the bosom of a mountain lake, and see her climb the heavens visibly, as though she walked along the dark brow of that heathery mountain, until she disappears behind the rugged cliff at the summit, while a silvery, hazy twilight is shed around — now trembling on the rippling water, now dropping like diamonds from the glistening oar; now bathing in its pale beams each rugged feature of the peaceful scene, while the deep, dark shadow lies, all the while, like a giant slumbering under the great mountain's breast. Or, walk through the green forest glades of Old England by moonlight, when her broken beams come gleaming through the leaves and shadowy boughs, in a thousand fantastic shapes and bright patches upon the calm, green sward beneath, or illumine the trunk of that old, knarled oak, or the white bark of the birch. See her trembling upon the calm river or streamlet; or flashing back from the diamond panes of that quaint old church-tower, lighting up with ghostly splendour the marble monuments of the great within, or pouring a flood of peaceful light upon the quiet, green graves of the poor without. See her in mid-winter, shining down from the lofty zenith over a white waste of snow, and sparkling upon the frost-spangled leaves that glitter in her beams. Call up all these scenes successively to the memory, or seek them afresh in nature—let them be repeated ten thousand times, and each time ten thousand new beauties will meet the view. Yes, there is a calm loveliness and quietude about her light, that soothes the mind; there is a tender solemnity in her clear, yet mysterious beams that, viewed in the hour of stillness and repose, strikes on the varied chords of human feeling in a wonderful way, and, accordingly, the impression produced is not confined to any race or country — to any age or clime—from the group of our own merry children, who revel in her beams, shouting the well-known nursery rhyme—

> "Boys and girls, come out to play,
> The moon doth shine as bright as day,"

to the wild and untutored savage in the forest, who falls down to do her homage.

But the impression produced upon the mind untaught in the knowledge of the true God, is thus alluded to by Job—"If," he says, "I beheld the sun when it shines, or *the moon walking in brightness*, and my heart hath been secretly enticed, or my mouth hath kissed my hand, this also were an iniquity to be punished by the judge, for I should have denied the God that is above."—Job, xxxi. 27. The allusion here is to one of the most ancient and common forms of idolatry, proving indeed man's fatal alienation and apostasy from God — but proving not less certainly the powerful impression produced by the heavenly bodies upon the mind, so strong as to cause man to bow to *them* instead of his Maker. "Take good heed, therefore," says Moses, "lest thou lift up thine eyes unto heaven, and when thou seest the sun, and the moon, and the stars, even all the host of heaven, should'st be *driven* (*i. e.*, compelled) to worship them and serve them, which the Lord thy God hath divided unto all nations under the whole heavens."—Deut. iv. 19. What, we may ask, then, is the legitimate effect of all the wisdom and perfection to be discovered in the movements, and the glory, and beauty to be seen in the aspect of our satellite and her glittering companions. Once remove the gross film of idolatry from the eyes and mind of man, and all the full weight of the impression made ought naturally and directly to be transferred from the thing created to the Creator. Every contrivance of wisdom now apparent; every benefit and blessing conferred; every beauty impressed, should fill the swelling heart of enlightened man with an indescribable weight of gratitude and obligation, that he may return it again to the bosom of Infinite Love, from whence it proceeded.

But, alas, although this would seem to be the inevitable consequence in every case, it is far from being so in fact. It is not enough, in order to excite love to God in the heart of sinful man, that the grosser forms of idolatry should be removed; it is not enough that he should know that there is a God who has "made the heavens, and all the host of them;" it is not sufficient that he should be led to scorn the base notions that would lead him to bow to anything in heaven or in earth; it is not enough even that his philosophy should have taught him to know the constitution, and to measure out every movement of the bright spheres above, and to trace their cause and effect—to perceive the beautiful adaptation of the means to the end, and to be impressed with a deep sense of the wisdom, and skill, and power, and goodness, and love of their mighty Architect, as seen in his works. All this may be, and the mind may be exercised with glorious truth, and the brain be taxed to the utmost with abstruse calculations, and the heart and the feelings deeply agitated and excited even to the wildest enthusiasm by the grandeur, and glory, and sublimity, and beauty of the spectacle of the heavens, and yet no real good effected by it for himself, and the heart remain unmoved, unchanged, unconverted to God. This is ever the case, when, however familiar with God's works, man is not equally familiar with His Word—when knowing God well in the former, he is not willing to know Him in the latter. The utmost attainment of astronomical knowledge, or any other branch of natural science, can but ill compensate for this serious, this fatal defect. "Look from nature up to nature's God," we may and ought; but to look up at the magnificent array that is spread before us, without previous preparation of heart, and spiritual enlightenment of mind—without the knowledge of *His* character with whom we have to do, is to set sail on a boundless ocean without rudder, compass, or chart; it is like reading a book without knowing anything of its author; or admiring an ancient building, and contemplating the beauty of its proportions and its architecture, without knowing anything respecting its architect, its origin, or its history.

But for the temporary pleasure, indeed, it may confer, or the information it may impart to the world, such unsanctified knowledge of the physical world *without*, with total ignorance of the moral and spiritual world *within*, as it is revealed in the Bible, can do but little for a man; and even that little may prove injurious to his everlasting interests. God has given us two books to study—nature and revelation. Natural science and revealed religion, as studied by the world at large, are as two roads running parallel to each other, along which men frequently pass and re-pass through life, without an interchange of thought one with another; but little wonder they can never meet until inclined to each other by some power from without—then, this once being done, and ever so slight an inclination given of one towards the other, by the teaching of the Word and Spirit of God, and men will find themselves travelling, not along parallel lines, but the radii of a great circle, which must meet eventually, whose *centre* is God and His glory—Christ and his truth; and this is absolutely necessary to enable us to form a right conception of both. As time and space assume one and the same aspect under the close inspection of astronomical knowledge, so, no doubt, it will be found hereafter that natural and revealed religion will prove to be but one great science. While we are here, however, they assume a two-fold aspect; and if the study of the laws that govern the natural world is necessary in order to understand nature aright, equally necessary is the study of the laws which govern the great moral world within us, as revealed in God's Word. If, indeed, a preponderance is to be given to either, it should be to the latter; for, after all, what is man, or in what does *his* greatness consist, but in the existence of this moral world?—where is it to be found if not in his mind? When compared to the material world, he is absolutely nothing—he is annihilated by the ponderous masses around him. But there is no greatness or littleness with God in this respect; and the same care is bestowed by Him upon the tiniest bluebell that lifts its head in the forest, as upon the lofty tree under which it is blooming—upon the smallest insect that hums in the summer air, or the down upon the butterfly's wings, as upon the largest animal whose heavy tread is heard upon the globe; the muscles of the ant's legs are as carefully adjusted to the earth's gravitation, as the thigh or trunk of the elephant. Of this care and beautiful adjustment, man has his share, and no more: and, though his bodily organization is more complicated and perfect, in many things he is far inferior to the lower animals, whose senses indeed are more acute, and whose physical powers are much greater than those of their lord and master. But it is the *mind*—the *immortal* part, that makes the mighty difference—endued with the wonderful powers it possesses, and having the indestructible nature that it has, in the sight of God Himself it assumes a preciousness which no language can adequately express, and which, alas! man cannot always feel for it himself. The wisest and the best of all Philosophers, however, has thus described its exceeding value to us, when he says—"What is a man profited, if he gain the whole world, and lose his own soul? or what shall a man give in exchange for his soul?"

"After all (says Dr. Paley), the most wonderful part of astronomy is, that man can know so much as he does." Confined as we are to the small space in which we move, who could ever dream that the atomic creatures of this globe have that within them that enables them to survey, not the spot of ground they walk upon, but the mighty universe of God—to hold, as it were, the sun in one hand and the moon in the other; and while as a grain of sand ourselves we stand upon the earth, to weigh it and its companion orbs, one against the other as in a scale—to determine their mass, and measure their mighty movements and distances, extending even to those apparently motionless bodies that sparkle like gems in the midnight sky, and whose remoteness is such, that even the mind is at fault in conceiving it perfectly, although it can compel figures to express it correctly?

All this man does with ease. But if this should elevate him in his own mind, the consideration of himself, as he is described in the Book of God, while, on the one hand, it humbles him to the dust as a sinner, on the other hand it elevates him far more—exalts him to the very throne, and presses him to the very heart of the King of kings and Lord of lords. If His works assure him of His provident care over him, His Word assures him of His tender love; of a love that knows no end, change, or decay—that is everlasting as the heaven of heavens, and infinite as the boundless universe. For him, not only was the earth prepared, and the heavens made to shine, but for him Christ died — for him a glorious immortality is prepared. Because man was precious in God's sight it was that the Lord of Glory—leaving the bosom of the Father, and that glory which he had in some far distant place in the universe, and, singling out, with the eye of mercy, this little speck of dust, lost, as we might imagine it to be, in the spangled ocean of the thousand times ten thousand worlds, brighter and larger than our own—made His way to the sinful children of Adam, to redeem at least a portion of them from their unhappy and lost condition. The voices of nature and revelation here unite; astronomy and revealed religion here combine in elucidating this wondrous truth, and break upon the mind like the morning glory of sunrise. A bright immortality rises from the ruins of our planet, presided over by the God alike of nature and of revelation.

The identity is perfect. It is the same God who ruleth all in all — the power, the wisdom, the skill in creation; the love, the mercy in redemption, all from the same source, and directed to the same end. If, then, we would read the heavens aright, we must read the Word of God aright; if we would understand the Word of God, and the redemption therein revealed, in its most enlarged and glorious view, we should sometimes study the heavens.

The day is coming, indeed, when the voices of nature and revelation will together testify and confess to each other's truth, and the glory of Him who is their common author; when the simple word in the poor man's Bible will be fulfilled, and echoed by the thunder-burst from above, which shall shake the heavens and vibrate upon earth — which shall awaken the dead from their graves, and a slumbering world from their apathy, with such a tempest of fire as shall turn the cold, pale moon to crimson, and blot the stars of heaven from the sight, and convert the green face of nature to "one red."

"The heavens shall pass away," says Peter, "with a great noise, and the earth shall melt with fervent heat, and the pillars of the earth shall be dissolved."

How this catastrophe is to be effected, we cannot tell precisely; but that it will happen we cannot doubt. The Word and works of God will then conspire together—the one to proclaim His faithfulness and truth, and the other to carry into execution His will; and there is little difficulty in conceiving this. The same Power that gave the great Newtonian law can, by a very slight alteration of it, produce very serious and mighty changes — in fact, such a catastrophe as we look for. But let this pass, and these two solemn witnesses will conspire again in a happier and more glorious manner.

"We look (says Peter) for a new heaven and a new earth, in which dwelleth righteousness." How is this to be understood? The study of astronomy is considered, not without reason, to be the most sublime, next to the Bible. This may be attributed not only to the lofty nature of the subject, and the elevating effect it is calculated to produce upon the mind, but from the fact, that once acquired, it is never lost. It will probably outlive this world, and endure in the mind for ever. In this respect, it may be distinguished from every other branch of knowledge of that class that treats exclusively of earthly things, and is what the Apostle calls that knowledge which shall vanish away. It seems to be one of the sad consequences of our strange position here, that all the labour and toil we may expend on the acquisition of knowledge, however valuable for this world, shall pass away with it, and, except for the training or exercising of the mind, and the developing of its powers thereby, no other benefit shall accrue from it; it shall be as though it never had been. Its object exclusively earthly, its end will have been accomplished when the earth has had its day, but it will find no entrance to heaven, for it is not needed there. This will, doubtless, apply to many useful branches of human knowledge and science; but astronomy, at all events, would seem to be an exception: it treats not of earthly but of heavenly things—not of this world alone, but of worlds innumerable, and far beyond the confines of our planet, and relating only to *its* concerns as to a part of a greater, and a wider, and more glorious system. The category under which this science can be placed, therefore, at once enrols it among the noblest kinds of knowledge; as a theme worthy of angels' study, as it was, unquestionably, of their song.—(Job, xxxviii. 7; Rev. iv. 10, 11.)

"The heavens declare the glory of God" (says David). The study of the heavens, therefore, is the study of the glory of God—this determines its character. If, then, it be permitted to man hereafter, like those bright spirits of whom we read in Holy Writ, to roam with the speed of light from world to world, from planet to planet, and from sun to sun,* astronomy is no lost science, and the time that we have given to it is no lost time, for we shall only enter upon its fuller attainment in the world to come; here we are but permitted to see the porch of the temple, there we shall enter it and span its starry dome, and contemplate its awful beauty; there possibly passing from the glory of one star to that of another; from one landscape of living beauty to another; from one cluster of brightness to another, we shall be permitted to measure the height, and depth, and length, and breadth, not only of God's power, but of God's love to all his creatures, and especially to His poor, fallen, sinful, but not forgotten creature, man. And as wearied with our flight (if ever our angel's wing can tire), we bend our way homeward, and enter the bright, astral cluster in the midst of which shines our own familiar sun, whose beams had warmed our childhood, and our own starry home, where the years of our sinful probation had passed away, with what exultant joy may we point to it changed, renewed, and purified, as it then will be, from sin and sorrow — the new heavens and the new earth, wherein dwelleth righteousness, henceforth the throne of the Son of God for ever, who, singling it out of His own wide dominions as the nucleus whereon to display His surpassing love in redemption, now sits down there as His seat and habitation for everlasting ages of joy unchanging—the same yesterday, to-day, and for ever.* Then the love He showed to man in the darker and earlier history of this planet, shall shine down upon his head in rays of blessedness and peace for evermore—a blessedness that shall be felt in every wind that blows, in every flower that blooms in that happy paradise, where "peace shall be as a river, and righteousness as the waves of the sea"—(Isaiah, xlviii. 18); where even the sun and moon shall be eclipsed by a more glorious and perfect light, for "the Lord shall be our light, and the everlasting God our glory."—(Isaiah, lx. 19.)

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* *Vide* Daniel, ix.; and Appendix H.

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* *Vide* Appendix I.

Appendix.

(A)

Several of these photographs have been taken. "All the alternations of light and shade affect an iodized plate (says Humboldt), and I myself possess such a light-picture of the moon, of two inches diameter, in which the so-called seas and annular mountains are clearly recognised; it was prepared by a distinguished artist, Mr. Whipple, of Boston."—(Humboldt's "Cosmos," vol. iii. part ii. p. 362.)

(B)

The *power* of a telescope here alluded to, by which the capabilities of these instruments are generally, though not truly expressed, relates to its *magnifying power* only. It is usual to express it thus, because when it bears a high magnifying power it must be a good telescope: yet there are other powers, or rather qualities, without which the magnifying power would be useless; such as its *penetrating power*, by which the image formed is repeatedly painted with light, and from being faint is rendered strong. This depends upon the size of the object-glass, being in proportion to its surface or area, every point of which receives and transmits an entire picture. Then there is its *acromatic power*, or freedom from colour, produced by the different refrangibility of the rays of light, and—perhaps the most important of all—the power by which it is freed from spherical aberration, the effect of which is mistiness and want of clearness. The *magnifying power* is as the focal length of the object-glass divided by that of the eye-glass, so that the same eye-glass will produce different powers, according to the focal length of the object-glass with which it is combined; and, *vice versa*, different eye-glasses will produce different powers. The highest power applied with advantage (*i.e.*, preserving the other powers) to the moon is about 500, although I have seen her with a power of a thousand in Lord Rosse's twenty-feet reflector, but not so satisfactorily as with a much lower one. To the fixed stars much higher power may be applied with impunity.

(C)

The old method of computing the heights of lunar mountains, was to measure with a micrometer the distance from the top of the mountain the moment it first becomes illuminated to the terminator, or circle of light and darkness, in a direction perpendicular to the line joining the extremities of the horns. The practical difficulties attending this mode of measurement, however, have rendered it obsolete. It could, in fact, only be done at all when the moon was elongated 90° from the sun, and the measurements made by it are not now considered correct, having exaggerated the heights of the lunar mountains far beyond what more recent and accurate measurements allow. These are now made by careful measurement of the *shadows* with the micrometer.

It is a curious and interesting circumstance, that the possibility of this latter mode of measurement was suggested in very early times, when no telescope existed. "Plutarch, in his small but very remarkable treatise on the face of the moon," says expressly that in the spots which we see we may *surmise* the existence partly of deep clefts and valleys, and partly of mountain summits, "*which cast long shadows like Mount Athos, whose shadow reaches to Lemnos.*"

Humboldt, in that most wonderful and interesting work of his "The Cosmos," adds an extract, in confirmation of Plutarch's observation, from a celebrated traveller, Pierce Belen, who, in a work of his, published in 1554, upon the "Remarkable Objects found in Greece," says:—"The shadow of Mount Athos reached to the broken figure of a cow in the market-place of the town of Myrine, in the island of Lemnos."

Mount Athos, on the coast of Macedonia, stands in lonely majesty at the extremity of the peninsula or promontory that bears its name, and rises abruptly from the sea to the height of 6849 feet. The distance to which its shadow must be projected across the Mediterranean, according to the above statement, cannot be less than thirty miles, at which distance from the shore Lemnos is situated. In connexion with this subject, may be mentioned an opinion or theory suggested to me lately by a friend, respecting the lunar spots, which he fancied he had been the first to imagine, but which (as there is nothing new under the sun) turns out to be as old as the days of Plutarch, and to have been actually contested against by that celebrated and sagacious historian, viz., that the spots and shades on the moon are only the reflection (as in a mirror) of our continents and oceans. So convinced was this gentleman of the truth of his theory, that he got a friend in the West Indies to sketch a map of the lunar spots as they appeared there, conceiving rightly upon this theory, that if it were true she would present a different face. I have this rough sketch in my possession at present, but, notwithstanding all the efforts of my friend to convince me of the difference, I am sorry to say I am still too dull to perceive it. Humboldt thus alludes to it:—"Another '*very fanciful opinion*' respecting the spots in the moon, was that of Agesianax (contested by Plutarch), according to which the moon's disk was supposed to reflect back to us catoptrically (as in a mirror) the forms and outlines of our continents, and of the outer (Atlantic) sea." "An opinion quite similar to this (says Humboldt) seems to have continued as a popular belief in Western Asia to the present day." Finding it vain to contest the matter any further with my friend, I was rejoiced to have it in my power to hand him over to Plutarch and Humboldt. As a consolation to him, however, I may here add an anecdote of Humboldt, which shows at all events, that his theory, if not correct, is at least *natural*:—"I was once very much astonished (he says) to hear a very accomplished Persian of Ispahan, who had certainly never read a Greek book, to whom I was showing, in Paris, the spots on the moon's face through a large telescope, propound the same hypothesis of reflection as that of Agesianax as prevalent in his own country. 'It is *ourselves* we see in the moon (said the Persian)—that is the map of our earth.' One of the interlocutors in Plutarch's conversation on the moon would not have expressed himself otherwise" (Humboldt's "Cosmos," vol. iii. part ii. p. 2, chap. cxxx.); nor would my, I believe, as yet unconvinced friend.

(D)

Hooke says, speaking of this experiment with boiling alabaster:—"Presently ceasing to boil, the whole surface will appear all over covered with small pits, exactly shaped like those of the moon." "The earthy part of the moon has been undermined or heaved up by eruptions of vapour, and thrown into the same kind of figured holes as the powder of alabaster" (Robert Hooke's "Micographia," 1667; Note, Humboldt's "Cosmos," vol. iii. part ii. p. cxxxi.) It is now debated among geologists whether there are any volcanoes (properly speaking) in the moon, and whether her present state is not the effect of her cooling down from a state of fluidity (like Hooke's alabaster), especially as it is *said* by some that there are no lunar mountains with a crater or hollow at the summit. Unfortunately, however, for this theory, two are known to have them—viz., Arzachel (a mountain in the very centre of the moon), which has a crater on its very summit; and Hercules, which has a lateral crater. We should think a journey there alone could solve this question.

(E)

The following description, by Sir C. Napier, of Trukkee, in India, referred to in the plate, affords an instance of a *terrestrial* crater (now extinct), which bears a strong resemblance in its formation to those of the moon—as, indeed, it would seem the whole of that wild and dreadful volcanic district traversed by that officer and his brave companions does, to the lunar regions in the moon's southern portions, and in the neighbourhood of Tycho :—

"The general, after examining with great labour and fatigue all the approaches, scaled a high rock, from whence he looked into the interior of Trukkee, and formed a plan of attack — to be executed, however, only in the last extremity, for the place was indeed worthy of its reputation. Resembling an extinct crater, it was twelve miles long, by five or six broad; and nature had most curiously contrived it—alike for secrecy and strength. For strength, because externally it presented a belt of rocks many hundred feet high, and nearly impracticable of ascent on the south side; and though it was less austere on the north, the inside there was precipitous, while on the southern side it was comparatively easy of descent. Thus the whole circuit was equally impervious to assault; and the interior was a vast collection of rocky hillocks, with chasms of different depths, yet all precipitous.

"For secrecy, because on the south was a second wall, or screen of perpendicular rocks, some hundred feet high, forming, with the actual belt of Trukkee, a restricted valley, or rather lane, which was to be entered by narrow fissures before the passes into the crater could be approached; and all the country for miles around, beyond that screen, and adjoining the true wall, was a chaos of huge loose stones, which it was hardly possible to cross. *The entrances to this hidden fastness, which seemed like some ruined colossal amphitheatre, were mere cracks in a wall of rock, so suddenly opened that the upper parts seemed still to touch, and refused to let in the light.* There was abundance of water inside; and just outside the fissure by which the robbers retired after their attack on the convoy, there was a copious hot spring, wholesome to drink, yet forbidden to the troops by matchlock-men, perched on landing-places in the side of the precipitous crags."

(F)

By this is meant, no heat perceptible by bodily sensation. Up to a very recent period, indeed, it was considered that no heat was actually produced by the moon, and various experiments with powerful lenses, directed to the bulb of the thermometer, failed in raising the temperature the smallest fraction. That recent and careful experiments have been more successful, however, we find by the following testimony of Humboldt:—

"That the light of the moon *does* produce heat, is (like so many others due to my celebrated friend, Melloni) among the most important and most surprising discoveries of our century. After many unsuccessful attempts—from La Hire to those of the acute Forbes—Melloni, by means of a lens (*lentille a échelons*) of three feet diameter, made for the Meteorological Institution, on the cone of Mount Vesuvius, succeeded, in different phases of the moon, in observing most satisfactory indications of an elevation of temperature. Mosotti, Lavagna, and Belli, Professors of the Universities of Pisa and Pavia, witnessed these experiments, the results of which varied according to the moon's age and altitude. To what amount, expressed in fractional parts, of the centrigrade thermometer the increase of temperature produced on Melloni's thermoscopic pile corresponded, had not then (in the summer of 1846) been examined."—(Humboldt's "Cosmos," vol. iii. part ii. pp. 358, 4.)

(G)

The following extract, from Mr. Hind's beautiful and interesting little work on the solar system, will give some idea of the labour of such calculations:—

"But the most important work undertaken for perfecting our knowledge of her movements, and one which is hardly equalled for magnitude and intricacy in the history of astronomy, is the reduction of all the observations of the moon taken at the Royal Observatory, Greenwich, between the years 1750 and 1830, which has been brought to a completion within the last few years, under the superintendence of the Astronomer Royal. There are about 8000 observations in all, and, for the attainment of the object in view, it was necessary to reduce the whole again, with the best modern elements, to compute the tabular places in duplicate, the tables themselves having been modified and extended so as to accord as nearly as possible with M. Plana's theory, and finally to determine the principal elements of the moon's motion, from the whole mass of observations. Few persons who have not had an opportunity of viewing the manuscripts themselves, can form any adequate idea of the enormous labour attending this valuable work. Twelve computers, on an average, were engaged eight hours a-day for several years, the reductions having been commenced in earnest in August 1841, and the last sheets of the second large volume, containing the results, having passed through the press in the spring of 1848."

(H)

That the word *ισαγγελοι*, used in the latter passage, should not be confined to the particular case referred to, is, I think, evident from the very nature of the expression. If man is to be "equal to the angels," we must suppose an equality, not in one but in all particulars. This resemblance opens (without entering minutely into matters with which we are not acquainted) a glorious and happy prospect for man. Selecting only one of those powers which angels we know possess—that of rapid and boundless motion—what a deeply interesting thought is suggested?

The following passage, from Dr. Dwight's "Theology," will best explain it:—

"In Luke, xx. 36, our Saviour declares that the righteous will in the *αναστασις*, or future state of existence, be *ισαγγελοι*; literally, 'equal to the angels;' but perhaps intended here to denote, 'like the angels;' that is, possessing in a near and kindred degree the attributes which they possess. Accordingly, in the fourth chapter of the Apocalypse, we are taught that the four-and-twenty elders, the representatives of the ancient and modern churches, are placed round about the throne, together with the four living ones, the representatives of the angelic host. The resemblance here exhibited is such as strongly to exemplify this declaration of Christ. Their station is substantially the same; their employments are the same.

"The activity of angels is disclosed to us by the Scriptures in many passages, and in language of the greatest force. The ninth chapter of Daniel particularly contains, as I observed in the first discourse concerning these glorious intelligences, a remarkable illustration of this subject. Here we are told, that Gabriel received a command in heaven, while Daniel was employed in prayer, to interpret his vision; and that 'being caused to fly swiftly, he touched Daniel about the time of the evening oblation.' The activity here declared is plainly superior both to conception and calculation; and exceeds that of the sunbeams beyond any proportion perceptible by our minds. Similar to this representation will be the activity of the righteous in the future world.

"To recur to the illustration adopted in the former part of this discourse. We are now, as we are styled in the Scriptures, worms of the dust: slowly and humbly creeping upon the earth, appointed for our habitation. With these reptiles we die, and are lost in the tomb. Like them also we shall revive to a new and nobler existence! and wander freely at our pleasure, through regions shut to us hitherto by an immovable law of our nature, and to our apprehension existing only in argument or fancy.

"To act is the end of all rational existence, and to act at pleasure the necessary concomitant of happy existence. Like Moses and Elias, if we obtain a part in the first resurrection, we may hereafter visit distant worlds, with incomparably more ease than we can now pass from one continent to another; and find the oceans of space by which they are separated merely means of illustrating our activity, and furnishing delightful opportunities of expatiating at our pleasure."—Dwight's "Theology," Ser. clxv., p. 818.

See also Faber's "Many Mansions," p. 184; and Barnes' Note on 1 Peter, i. 12.

(I)

That this is the *Scriptural* as well as *rational* view to take of the Apostle's statement, I think there can be little doubt. The earth will not be annihilated by the final conflagration, but renovated, changed, and purified, so as to be rendered a fitting abode for the redeemed; who, united to their new bodies, although not necessarily confined to the earth, will inhabit it as their happy home for evermore; where Jesus will be their King and Lord, and all his power and goodness, which we see so wonderfully exhibited to us here, will be put forth to embellish and adorn the place consecrated by the memory of His dying love, and henceforth a fitting antitype of the paradise of God, in the midst of which He sits as the tree of life, to dispense happiness and blessing unspeakable to the thousand times ten thousand immortal beings whom He has saved. Any attempt, indeed, to describe the precise nature of the change that will be made in our planet in order to produce this, would be as vain as to endeavour to explain the nature of the bodies we shall then possess. But that it will be this identical material world is, I think, as plain as that we shall be our identical selves, and is evident from the testimony of Peter, as of many other parts of Scripture; and, in some degree, indeed, it is not so difficult to imagine a paradise composed of a greater amount of glory and beauty imparted to scenes resembling those with which we are familiar here. We have only now to select one of the most beautiful of those spots that we can recall to our memory on earth—to choose the moment when it looks most to advantage, to invest it with the sweetest and most cherished and hallowed associations, to take the happiest and most buoyant and delightful moment of our existence, when no cloud was upon our mind, no care was on our brow, or sickness in our frames, or sorrow in our hearts—we have only to surround ourselves with the friends and relatives we love best in the world—to banish sin altogether, and, above all, to add the presence of Him "whom, not seeing, yet we love," and write upon all this the word PERMANENCE, and our happiness would be complete; we should "rejoice with joy unspeakable and full of glory," and earth would be at once a paradise.

The opinions of many eminent theologians are in accordance with these views. Thus Bishop Burnet says:—"I know it is the opinion of some that this world will be annihilated, or reduced to nothing, at the conflagration, and that would put an end to all further inquiries. But where do they learn this? what instance or example can they give us of annihilation? or what place of Scripture can they produce that says the world in the last fire shall be reduced to nothing? If they have neither instance nor proof of what they affirm, it is an empty imagination of their own, neither agreeable to philosophy nor divinity. Fire does not consume any substance, it changes the form and qualities of it, but the matter remains, and if the design had been annihilation, the employing of fire would have been of no use or effect, for smoke and ashes are at as great a distance from nothing as the bodies themselves out of which they are made."

With regard to the Scriptural evidence, he continues:—"The prophets both of the Old and New

Testament have left us their predictions concerning 'new heavens and a new earth.' So says the Prophet Isaiah — 'Behold I create new heavens and a new earth, and the former shall not be remembered or come into mind (chap. lxv. 17), as not worthy our thoughts in comparison of those that will arise when these pass away.' So the Prophet John, in his Apocalypse, when he was come to the end of this world, says—'And I saw a new heaven and a new earth, for the first heaven and the first earth were passed away, and there was no more sea' (Apoc. xxi. 1); where he does not only give us an account of a new heaven and a new earth in general, but also gives a distinctive character of the new earth, that it shall have no sea; and, in the fifth verse, He that sat upon the throne says, 'Behold I make all things new!' which, considered with the antecedents and consequents, cannot be otherwise understood than of a new world."

With reference to the allegorical mode of interpreting the promise of the new heavens and earth, he says:—"Here is no room for allegories or allegorical expositions, unless you will make the conflagration of the world an allegory; for as heaven and earth were *destroyed*, so heaven and earth are *restored*, and if in the *first* place you understand the *natural material* world, you must also understand it in the second place—they are both allegories or neither; but to make the conflagration an allegory is not only to contradict St. Peter, but all antiquity, sacred or profane; and I desire no more assurance that we shall have new heavens and new earth in a literal sense than we know that the present heavens and earth shall be destroyed in a literal sense, and by material fire. Let it, therefore, rest upon that issue as to the first evidence and argument from Scripture."—(Burnet's "Theory," pp. 516–18.)

The following beautiful passage, from a modern commentator, confirms the foregoing idea:—

"That the earth may again be revisited from time to time by the redeemed, that in a purified and renovated form it may be one of the 'many mansions' which are to be fitted up for them (John, xiv. 2), may not appear wholly improbable from the following suggestions:—1. It seems to have been a law of the earth, that in its progress it should be prepared at one period for the dwelling-place of a higher order of beings at another period. Thus, according to the disclosures of geology, it existed perhaps for countless ages before it was fitted to be an abode for man; and then it was occupied by the monsters of an inferior order of existence, who have now passed away to make room for a nobler race. Who can tell but the present order of things may pass away to make place for the manifestations of a more exalted mode of being? 2. There is no certain evidence that any world has been annihilated, though some have disappeared from human view. Indeed, as observed above (Notes, ver. 10), there is no proof that a single particle of matter ever has been annihilated, or ever will be. It may change its form, but it may still exist. 3. It seems also to accord most with probability, that, though the earth may undergo important changes by flood or fire, it will not be annihilated. It seems difficult to suppose that, as a world, it will be wholly displaced from the system of which it is now a part, or that the system itself will disappear. The earth, as one of the worlds of God, has occupied too important a position in the history of the universe, to make it to be easily believed that the place where the Son of God became incarnate and died, shall be utterly swept away. It would, certainly, accord more with all the feelings which we can have on such a subject, to suppose that a world once so beautiful when it came from the hand of its Maker, should be restored to primitive loveliness; that a world which seems to have been made primarily (see Notes, 1 Pet. i. 12) with a view to illustrate the glory of God in redemption, should be preserved in some appropriate form to be the theatre of the exhibition of the development of that plan in far distant ages to come. 4. To the redeemed, it would be most interesting again to visit the spot where the great work of their redemption was accomplished; where the Son of God became incarnate, and made atonement for sin; and where there would be so many interesting recollections and associations, even after the purification by fire, connected with the infancy of their existence, and their preparation for eternity. Piety would, at least, wish that the world where Gethsemane and Calvary are should never be blotted out from the universe. But (5) if, after their resurrection and ascension into heaven, the redeemed shall ever revisit a world so full of interesting recollections and associations—where they began their being, where their Redeemer lived and died, where they were renewed and sanctified, and where their bodies once rested in the grave, there is no reason to suppose that this will be their permanent and unchanging abode. It may be mere speculation, but it seems to accord best with the goodness of God, and with the manner in which the universe is made, to suppose that every portion of it may be visited, and become successively the abode of the redeemed; that they may pass from world to world, and survey the wonders and the works of God as they are displayed in different worlds. The universe, so vast, seems to have been fitted up for such a purpose, and nothing else that we can conceive of will be so adapted to give employment without weariness to the minds that God has made, in the interminable duration before them."—*Barnes on* 2 *Peter*, iii. 10.

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